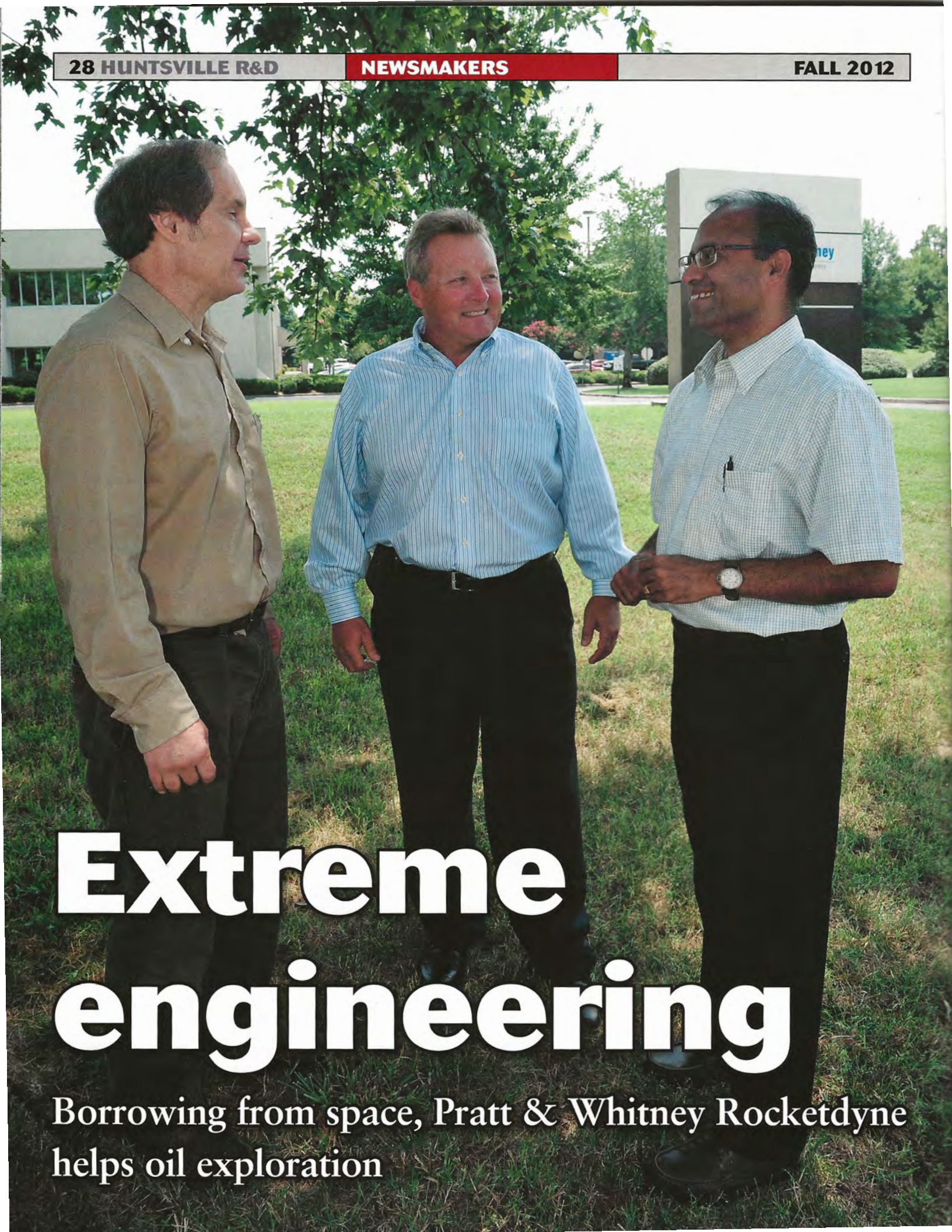

Extreme engineering

Borrowing from space, Pratt & Whitney Rocketdyne helps oil exploration

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By Kimberly Ballard

Sure, in this area, it has always been about the engineering. But for Pratt & Whitney Rocketdyne's Power & Energy Solutions division, it is more about Huntsville's *extreme* engineering capabilities. Like strapping a man to a rocket reaching temperatures in excess of 6,000 degrees, launching him thousands of miles into the harsh, frigid vastness of outer space and returning him safely to Earth. *Yeah, those extremes.*

Pratt & Whitney Rocketdyne, or PWR for short, has a 60-employee multidisciplinary engineering team based at Cummings Research Park to grab the gusto from Huntsville's complex engineering prowess and adapt it to the extreme environments of offshore oil and gas exploration. The goal is to allow oil exploration to thrive in ever-harsher environments with greater margins of safety and efficiency.

"There is a different value proposition in the oil and gas industry," says Mike McKeon, director of extreme engineering at PWR Huntsville. "It is a matter of economics. They ask 'How much do you want to invest in new technology?' and then they strategically make decisions based on what they know, and put their money on where they want to go." This pattern of investing in research, development, and new technology to make consistent improvements is what keeps natural gas and oil drilling systems from becoming archaic even though they have been around for a while, he says. Yet since the Deepwater Horizon Oil Spill disaster, exploration companies have been looking less inside the industry and more outside the industry for input about how to do things better.

In the wake of the Gulf oil spill, the oil industry needed the same capabilities for fixing their problems that the space industry applied when faced with highly visible space disasters. "That's when we stepped up our game and became instrumental in offering solutions that make offshore drilling safer, more efficient and more reliable," McKeon says. "PWR in Huntsville has new technology that we can integrate with older technology to produce better ways

Eric Schultz

Alan Minick, left, Mike McKeon and Suri Perinkulam talk in front of PWR on Discovery Drive.

of extracting natural gas and oil."

PWR's research in energy technology started in 1980 following an Arab oil embargo that caused a gas shortage in the United States. Ten years ago, a PWR customer with expertise in nuclear power and aerospace engineering was working at an oil and gas industry site and approached the company with a critical engineering issue. PWR was able to solve the problem and that expertise leveraged it into the offshore gas and oil industries. Today the focus is on energy conservation, uncovering new forms of energy and clean energy with low carbon emissions.

In the past couple of years, PWR found in Huntsville the skill sets needed to place a greater focus on energy technology. Software design and development, versatile technical and analytical skills, complex systems engineering and integration, and modeling and simulation capabilities all translate well into energy-based engineering. In fact, the space program faced many of the same challenges that deep-sea oil and gas exploration, oil recovery and solar power technology face.

Deepwater problems like changing currents, saltwater corrosion and extreme water temperatures and pressure all affect modern offshore oilrigs. These hostile environments are not unlike those found in space. As the industry pushes into more severe environments like the Arctic, where abundant reserves of oil and natural gas lie beneath an environment as harsh on the surface as it is under the ice and freezing seawater, PWR Huntsville is using modeling to simulate those conditions and the engineering required to be successful in them.

"Many of our competitors have one or two capabilities, but Huntsville brings full integrative engineering that is helping grow an entire industry," McKeon says. "I think we are in a nice spot right now, well-positioned for the future in the energy industry."

There is another connection between the space and oil exploration industries. Offshore oilrigs, like rocket systems, are very complex and expensive to operate. "Unplanned downtime caused by a software glitch on an offshore oilrig in the Gulf of Mexico can cost a driller anywhere from $500,000 to $750,000 a day," McKeon says. "Companies cannot afford for those systems to be down. The space industry evolved with human safety on the front end and at the core of its design. Safety and reliability have always been the central elements of the space industry. If the systems fail, lives are at stake.

"The oil and gas industry has always been a commercial industry, driven by economics," he says. "They have been leaders in safety. Offshore oil drilling has never been unsafe. The high-risk elements have always been centered on making sure there is as little downtime as possible. As a result, they have never used the rigor of the space industry on the front end."

One of the missing links in oil and gas industry technology is an ability the space industry has to predict and prevent major disasters or "unplanned downtime" based on risk assessment. Complex space launch systems always utilize an Engineering Risk Assessment (ERA). Applied to oil exploration, using ERA to look at the overall oilrig system in advance, identify the risks associated with that system and then initiate a plan to mitigate against those risks is a capability born from Huntsville's multidisciplinary engineering toolbox.

"By being able to assess potential failure mode on critical equipment as part of the design, offshore can take a major step forward. Modeling and simulation capabilities are critical engineering elements," McKeon says. "Many systems for the oil and gas industry were built without looking at the elements. By doing the modeling and simulation up front, and with higher levels of integration in the design, we can characterize systems and subsystems and pass that knowledge on to the

offshore industry."

Adding these layers of safety to the existing oil and gas exploration technology in no way means that the industry has been reckless or casual about safety in the past, McKeon says. The new approaches further improve on that record of safety awareness. "They have very high standards but the industry grew up through experimentation. They just have different levels of risk tolerance than the space industry and now with help from PWR, they are upping their game to ensure safety and reliability."

PWR has also developed a Downhole Steam Generator for oil recovery that acts on the same oil viscosity principles at work in your car engine. Using clean steam to heat the crude oil and lower its viscosity makes it easier to pump to the surface.

Also, the PWR team is using Huntsville's software capabilities to make progress in the Concentrated Solar Power technology (CSP) industry. "There is a huge opportunity in Huntsville for software development, and modeling and simulation to develop control systems for solar heliostats," McKeon says.

Heliostats are a collection of mirrors that reflect sunlight toward a collector that stores all that gathered energy in one place. The position of the sun in relation to the Earth changes constantly and large capacity power parks and other solar powered operations require thousands of these mirrors, all moving at coordinated times to track this movement. "It requires highly complex algorithms to move them into the right position to collect optimum light," says McKeon. "The Huntsville site has been instrumental in developing software that controls this process."

PWR also utilizes Huntsville's material science engineering, combustion engineering and fluid control mechanics to develop molten salt technology for extreme-heat flux environments used in CSP technology, adapting the space industry's methods for controlling extremely high temperature ranges like those produced by rocket engines.

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