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# OSU team still buzzing over run at electric-car land-speed record

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Wendover, Utah- As the sun's first rays tint the moonscape of the Bonneville Salt Flats, Craig Taylor aims the long, slender nose of his four-wheeled land rocket at a distant mountain peak and waits for the go signal.

In his 61 years, the Texan has catapulted jets off the decks of heaving aircraft carriers, caught flak on combat sorties in Vietnam and won championships racing Indy-style cars. But this is foreign territory.

His fire-resistant gloves clench the wheel of a vehicle that draws stares from even the most hardened gearheads in this Mecca for fast, exotic cars. Under its scarlet-and-gray shell, just behind the nose with its distinctive "O" logo, are stacks upon stacks of what look like batteries from kids' toys. And hovering around the car with screwdrivers and diagnostic computers is a group of 20-somethings in whose hands Taylor is about to place his life.

The young men and women, all current or former Ohio State University students, most engineering majors, dreamed this car into existence. The Buckeye Bullet was born only 41 months ago on the back of a napkin in a Columbus Mexican restaurant. With the help of faculty members and sponsors, and after thousands of hours of work that earned no classroom credit but taught a garage-full of life lessons, the Bullet team is poised to put its car to the ultimate test.

With a high-pitched whine, it rolls off the start line and heads across the ancient sea bed as Taylor dials up the power. For four frustrating days last week, the Bullet flirted with a national speed record for electric vehicles. A blown clutch, balky electronics, fried batteries, leaky tires and troublesome braking parachutes combined to keep the 251-mph mark just beyond the team's grasp. Yesterday was their last chance at the record until next fall.

From gasoline to steam to rocket fuel, just about every kind of propellant has powered just about every kind of vehicle on the Bonneville Salt Flats. The 30,000 acres of sodium chloride desert is the color of newfallen snow and as flat and featureless as the lid of a Maytag washer. Its glass-smooth, concrete-hard-surface has lured speed junkies since the early 1900s. But electric vehicles are a relative rarity here.

The current speed record has stood for four years, set by a professional California racing team that reportedly spent more than $2 million on its car, four times the Bullet's cost. The big car-makers in Detroit and Japan have just begun to tiptoe into commercial electric vehicle manufacture, cautioned by the complexities of battery technology and the public's dislike of driving anything that has to be recharged.

A new challenge Members of the OSU team didn't have to worry about consumer satisfaction; all

they answered to was a need for speed. Students working with the university's Center for Automotive Research and the Engineering Experiment Station already had gained experience and won numerous races with the Bullet's predecessor, an electric-powered Indy-style race car called the Smokin' Buckeye.

But after seven years, the novelty was wearing off. Plenty of other colleges had built similar cars. The OSU engineers needed a new challenge.

The idea of breaking a speed record was hatched over chips and salsa in the spring of 2000. Jeff Kletrovets, at the time president of Shoemaker Industrial Solutions, the supplier of the Smokin' Buckeye's electric motor, had seen a TV show about the car that held the current record. Could the OSU team do better? "We were all interested," said Jenny Sopko, who graduated in 2002 with a master's degree in mechanical engineering and is now a test engineer for Caterpillar Inc. "Whether we could do it was the challenging question." Sopko's teammate and future husband, Tom, began scribbling designs and horsepower calculations on a napkin.

Barely 17 months later - an eyeblink by Detroit standards - the pen tracings had become a long, low, slingshot of a car. Its 30-foot-long, 2-foot-wide pencil-shaped body was molded of carbon fiber and tested in a wind tunnel. Its small electric motor, the size of a beer keg and containing 5 miles of tightly wound copper wire, could churn out more than 500 horsepower, about four times that of the average compact car. Six feet of space behind the front wheels was taken up by more than 12,000 nickel-metal hydride batteries, stacked 12 high and swaddled in shrink-wrapped plastic sleeves.

Electrical-team leader Ryan Somogye, a thin, intense master's degree candidate in electrical engineering, tested lots of batteries before settling on a type like those used in radio-controlled model cars. They're capable of rapidly discharging their power load for the Bullet's short, furious spurts. A box of electronics that looks like a cable descrambler on steroids converts the batteries' direct current to the alternating current the motor uses.

In its first shakedown run at the Salt Flats in August 2002, the Bullet ripped through the 7-mile-long course at a top speed of 260 mph before mechanical problems shut it down. While faster than the national record of just over 251, the Bullet's mark wasn't official because it couldn't be repeated in a second run. The all-time land-speed record is 763.035 mph - faster than the speed of sound - and was set Oct. 15, 1997, in Nevada.

The OSU team, with some recently graduated alumni helping out, returned to the Flats last week hoping not only to break the national record, but also to join the exclusive 300 mph club. They had made numerous improvements to the Bullet. As in any complicated technical endeavor, however, from microsurgery to a moonshot, success depends not just on preparation, but also on problem-solving and more than a little luck.

The first run On Wednesday, the Bullet team arrives on the salt before daylight. At 7:30 a.m., sunrise is still an unfulfilled promise. The contrail of an eastbound jet scratches a pink exclamation point in the lightening sky. Vehicles of every imaginable style and vintage, from a Model A Ford to low-slung drag bikes and brawny hot rods, are driven or towed across the hardpack to the staging area. As the Flats' eerie surface transforms from gray to white, one engine after another awakens with a throat-clearing rumble.

The Bullet needs no such warmup. Its batteries are fully charged, a process that requires about an hourlong connection to a high-voltage generator. Team members make last-minute checks, tightening bolts and using duct tape to seal seams where segments of the body fit together.

The Bullet is a "streamliner," meaning its wheels are covered by the car's aerodynamic outer shell for maximum wind slipperiness. The first streamliners to ply the salt were cannibalized military aircraft "drop tanks," the fuel pods that hang below the wings.

The Bullet, by contrast, was designed on a computer. Less than 2 inches separates its undercarriage from the salt's surface. Its racing tires are pumped full of nitrogen rather than compressed air, to reduce the chance they will swell in the desert heat and rub nearby parts.

Even Taylor's seat is custom-molded, to fit his 5-foot-4 frame. The diminutive driver is a former Navy fighter pilot with 170 carrier landings and 126 combat missions. A mechanical engineer and veteran race car driver, Taylor owns and operates a racing equipment business in Plano, Texas. He drove the Smokin' Buckeye before the Bullet.

With Taylor buckled in, the crew members pull down the tinted Lucite cockpit cowling.

To determine the windscreen's ability to withstand an impact should a bolt pop off at 300 mph, the students did a low-budget field test. They propped up the cowling in a field and fired rifles at it. BBs bounced off. So did .22 slugs. It took the most powerful shot, from a 30.06-caliber gun, to shatter the glass. Hence, the car number emblazoned on the Bullet: 3006.

Drivers use the first two miles of the course to build up speed, then are timed in the third, fourth and fifth miles. The last two miles are for deceleration. The two braking parachutes had better work. The Bullet's brakes are ineffective at speeds greater than 150 mph, and drivers who haven't managed to stop by the course's 7.5-mile mark will find themselves in what Bonneville officials call "a lot of crunchies" - Salt Flats-speak for an ungraded surface that's wind-whipped into teeth-rattling ridges.

Allowing the extremely narrow-wheelbased Bullet to turn the slightest bit sideways in the rough salt would put it in a catastrophic high-speed log roll. The car has extensive safety features, including a roll-cage, high-strength driver restraints and an on-board halon fire extinguisher system. Taylor wears a racing helmet and 15-layer fireproof suit as thick as a sleeping bag.

Still, no one wants to think about having to put the equipment to the test.

Finally, at around 10:30 a.m. Wednesday, the team's pickup truck nudges the sleek vehicle to the starting line. With a push, the Bullet takes off and is quickly out of sight over the horizon. Seconds later, the track radio channel crackles a disappointing message: "Ohio State crew, your vehicle is stopped just short of the two-mile mark."

'Done for the day' Back in the pits, a frustrated Taylor gives the team the bad news. The clutch was slipping badly, and when he shifted into second gear at 135 mph, the electric motor quit. Third-year electrical engineering student Joe Gorse hooks up the Bullet to a diagnostic laptop and looks at a graph of the car's performance during the aborted run. It shows a spike in the motor's rpm when the clutch failed to grab.

"We're done for the day, guys," Taylor says.

The only way to find out what's wrong is to tear the car apart. Nine team members surround the Bullet like surgeons over an open-heart patient. They unbolt the chassis cover and dig in, pulling out the battery packs, disconnecting the motor and using a wench to lift it out.

Somogye, the electrical-team leader, thinks the DC/AC power inverter's settings are part of the Bullet's problems. After last August's initial speed run at Bonneville, the controller was reconfigured to send more power to the motor. But it's been acting up in the last few weeks, interrupting the flow of juice, and the question is whether to switch back to last year's settings, sacrificing some power for greater reliability.

Meanwhile, team veteran Keith King, a senior history major with a love of drag racing, cracks open the clutch. Its pressure plates are made of aluminum to save weight, and one has melted and cracked under the strain. The team express-orders a replacement - this one made of steel - from

Taylor's racing shop.

Over the next two days, the mechanical glitches continue. On Thursday afternoon, Taylor coaxes the temperamental Bullet to a blistering 262.9 mph on a qualifying run, but not without a serious new problem: The high-speed braking chute makes wild 30-foot swings when it's deployed, yanking the car's rear end and threatening to throw it into a 250 mph rollover. Chute manager Isaac Harper, a sophomore in mechanical engineering who designed and built the quick-release mechanism, shortens the chute cord by 40 feet to try to compensate.

Early Friday morning, while preparing to go for the record, there's another flurry of bad luck. Overnight, the Bullet's right rear tire has developed a leak. Worse, the battery packs have overheated, rendering roughly one-third singed and unusable. Under the illumination of headlights, the team manages to get the car driveable in less than 90 minutes, but the inverter problems are back and Taylor manages only 241.2 mph.

With advice from a consultant who has flown in from Florida, team members reprogram the device to deliver more power to the motor. "It's not like you can drive this car every weekend," says Giorgio Rizzoni, director of OSU's Center for Automotive Research. "Every time we run, we learn something."

The fine-tuning works. Taylor hits a top speed of 271.4 mph in the afternoon qualifying run. It's faster than he meant to go, given the car's condition. The parachute oscillations are back, even worse, but he wrestles to hold Bullet upright and keeps the team's record hopes alive for the final day of speed runs. "I don't want to go through that again," says the jubilant but rattled Taylor.

A hopeful start Compared to the past week, preparations yesterday morning almost seem to go too smoothly. "Tires aren't leaking, batteries aren't burning," notes King. The team's mood is anxious but upbeat.

At five minutes to 9, the Bullet is at the starting line. Team adviser Maria Soliman pats the cockpit roof twice for luck, and the Bullet whispers away.

"That car went 271 mph yesterday on flashlight batteries," the course announcer says as team members cluster around a radio to hear reports of the Bullet's fate. Taylor does 232.7 mph in the first measured mile. The speed builds agonizingly slowly - the second mile is 238.3. Though the Bullet is traveling at roughly one-third the speed of sound, it feels like an eternity before the final mile speed crackles over the speaker: 242.3 mph.

Averaged with the best of Friday's times, the Bullet broke the national electric-car record by 5.6 mph. Team members whoop, hug and high-five, while other drivers and spectators applaud. Later, champagne showers the salty desert floor as the Bullet team celebrates.

"To the fastest man ever in an electric car, and to the team that got him there," toasts adviser Pete Miller. "You guys did it," Taylor says, embracing the young designers and dreamers one by one.

This is the last time together in the desert for some team members, who'll graduate and go on to automotive jobs they have gotten in part because of their Bullet experience. But others plan to be back on the salt next fall.

"The bar's been raised," says Isaac Harper. "We still have stuff to prove. The ultimate goal is 300 mph."

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