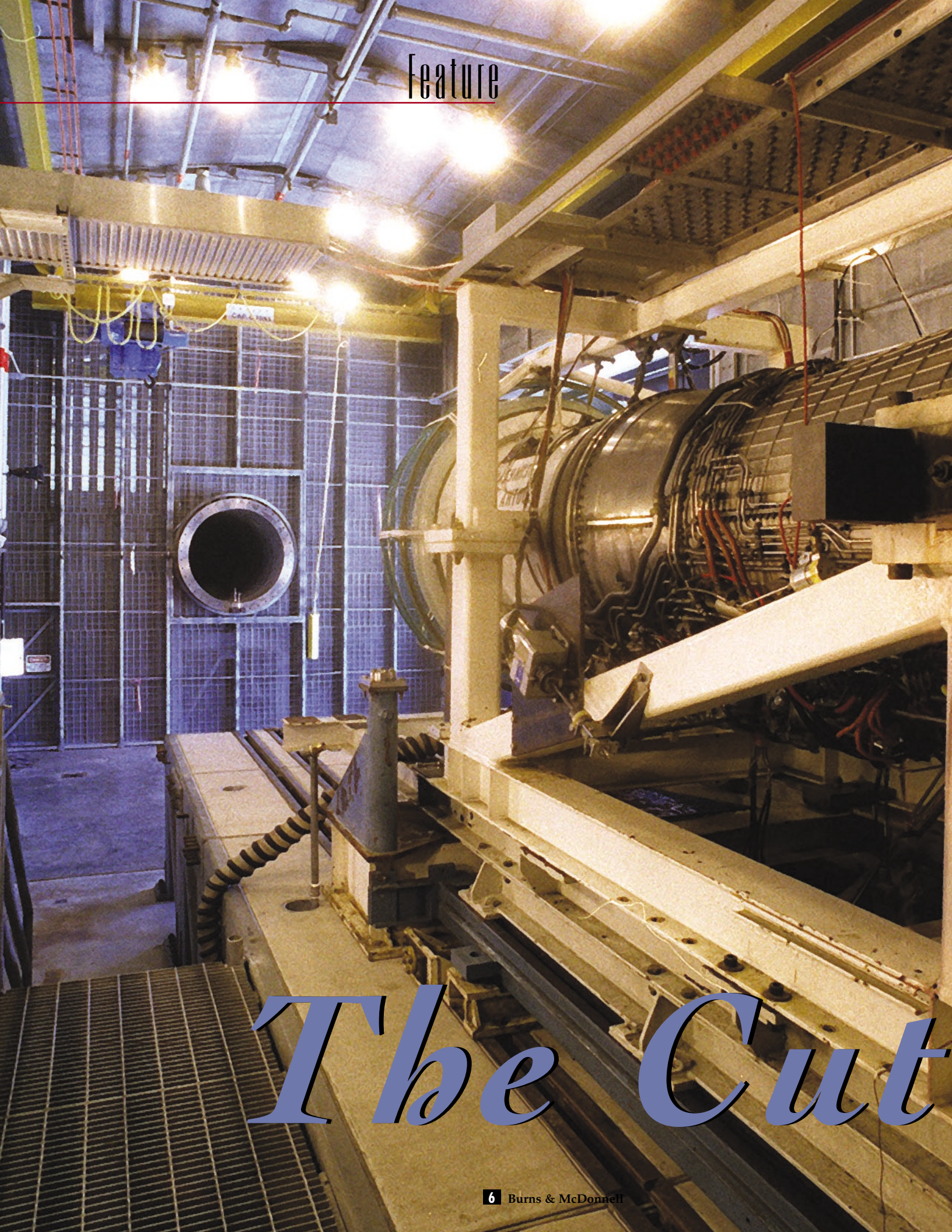

The Cut

Maintaining a strong and reliable military means making use of high-tech weaponry and equipment, and creating equally high-tech facilities to house and test them.

Within its 105-year history, Burns & McDonnell has years of experience creating state-of-the-art facilities that support the U.S. military's standing as the most highly trained, highly tested in the world.

"The reliability of U.S. military hardware is no accident," says Randy Pope, Burns & McDonnell associate vice president. "Burns & McDonnell has supported the mission of the military with high-tech facilities for years."

The Early Days

Burns & McDonnell's first foray into military support facilities coincides with its first major aviation project. Shortly after the bombing of Pearl Harbor in December 1941, the firm began designing runways to house the B-29 bomber at Smoky Hill Army Air Field in Salina, Kan. Burns & McDonnell designed and managed construction of runways, hangars, maintenance shops and barracks for the massive aircraft.

As World War II ended, Burns & McDonnell became involved in projects as the Cold War began. The firm selected pinpoint locations for Minuteman intercontinental ballistic missiles. Burns & McDonnell also designed several projects at the Atomic Energy Commission's Oak Ridge, Tenn., test site and support facilities.

As technology advanced, Burns & McDonnell embarked on more high-tech support facilities. In the 1980s, the firm designed portions of the High Energy Laser System Testing Facility (HELSTF), which was used to test lasers as part of the nation's early missile defense system program.

Burns & McDonnell designed ancillary facilities to support a 30-foot diameter vacuum chamber and 1500-foot-long stainless steel tube used to fire the chemical laser at its intended target. Burns & McDonnell also designed the mechanical and electrical systems in the chamber and an associated office building with a computer room to analyze data generated from the laser testing.

"The building had to be a highly pressurized environment so if the laser missed and struck the building, damage and injuries would be minimized," said Bill McCully, who was a project engineer on HELSTF.

F-22

The F-22 is one of the most advanced and admired fighter jets in the world. It would follow that the plane must undergo a rigorous set of tests before being used on the field of battle.

The radar cross section facility is one of several Burns & McDonnell has designed for the F-22. The facility tests coating on the plane that is designed to elude radar. Planes are brought into the 50,000-square-foot facility and placed on a turntable. A hoist is then attached to the nose and the plane is turned and lifted to various angles and shot with radar to test the coating's effectiveness.

Radar cross section refers to the extent to which the plane reflects the radar pulses. If the testing reveals that the aircraft can be detected on radar, it is sent back to the coating facility to be touched up. Burns & McDonnell also designed the coating facility, which is designed to generate laboratory-like conditions needed to apply the coatings that contribute to the aircraft's stealth capability.

Because of the precise nature of the work that goes on in the radar cross section facility, it is designed to specific standards, McCully says. Specialized paint, coatings and joint materials were used in the construction of the facility's walls to eliminate or minimize false radar images.

Extreme Testing

Jet engines, because of the altitude and speed in which they are used, are subject to extreme temperature, pressure and wind conditions. Putting their reliability to the test means duplicating those conditions on the ground.

ting Edge

Many of Burns & McDonnell's high-tech aviation facilities are designed to prepare militar properly in the conditions in which they will be used.

Burns & McDonnell has taken part in a number of projects that achieve just that purpose – to ensure that when those engines are put to use, they are mission ready.

At Arnold Air Force Base in Tennessee, one of the nation's top engine and rocket testing facilities, Burns & McDonnell designed for the Navy a high-end test cell to ensure that the Navy's jet engines would work properly in extreme environmental conditions.

"To ensure the reliability of the jet engines, they must be mission ready under all environmental conditions."

"Jet engines would seem to have a simple task – powering an aircraft," says Mike Roark, project manager for Arnold's jet engine testing. "But frequently those engines are operating in extreme conditions, making their jobs more difficult. To ensure the reliability of the engines, they must be mission ready under all environmental conditions."

Burns & McDonnell designed two environmental test cells for the task.

The cells are capable of testing 50,000-pound thrust engines at speeds higher than Mach 1. The engine for the F-22 Raptor fighter aircraft is among those that have been tested there.

The cells' air delivery system, also designed by Burns & McDonnell, provides the extreme atmospheric conditions. By introducing liquid nitrogen to the cell, the engine is cooled to simulate arctic conditions. The system delivers temperatures as low as minus 65 degrees Fahrenheit and as high as 260 degrees.

The Aerodynamic and Propulsion Test Unit at Arnold is being improved to test hypersonic airbreathing engines, which will be used to power the Department of Defense's next generation of flight systems.

The design includes a high-pressure air delivery system that delivers air through the engine test environment at speeds of up to Mach 8. The use of multiple freejet nozzles and a Sudden Expansion (SUE) Burner allows the cell to provide true temperature and aerodynamic testing of full-scale engines.

y aircraft to be used in combat or test them to ensure their systems or engines work

NASA

NASA has become synonymous with high-tech aircraft in the United States. Burns & McDonnell helped the government agency develop one of its premier testing facilities, the integrated test facility at Edwards Air Force Base in California.

Burns & McDonnell designed the 110,000-square-foot facility, which includes test bays large enough to accommodate six fighter-size aircraft or fewer larger aircraft. The facility connects the aircraft to flight simulators so the aircraft's on-board systems can be tested on the ground.

"The 'integrated' in 'integrated test facility' refers to integrating real-time flight simulation with the actual aircraft," says Paul Swisher, who was a mechanical engineer on the project.

The facility allows NASA to test the systems of its experimental aircraft, such as the High Alpha Research Vehicle (HARV), the X-29 and the X-31, while reducing the risk of actual flight tests. Tests such as time response, redundancy management, pilot evaluation and failure modes can all be performed from the relative safety of the integrated test facility.

Burns & McDonnell's work included nearly 58,000 square feet of lab and office space, computer rooms, equipment rooms, an electrical substation, a central hydraulic system, emergency diesel generation, uninterruptible power and aircraft-related power and cooling systems. Burns & McDonnell was also responsible for designing the facility's HVAC and mechanical systems and its chilled water plant.

NASA's HARV, X-29 and X-31 use innovative design and technology to create more maneuverable aircraft that are more effective in combat. That goal aligns with Burns & McDonnell's goal of providing the military with the facilities it needs to accomplish its mission.

"The 'integrated' in 'integrated test facility' refers to integrating real-time flight simulation with the actual aircraft," says Paul Swisher, who was a mechanical engineer on the project.