Facility begins engine testing excellence

SL-2 and SL-3 offer variety of testing

An engine's job seems simple enough—power an aircraft.

Yet, when an aircraft flies in less than favorable conditions, an engine's simple task becomes very difficult. With the sea-level cells in AEDC's newest facility, the Large Engine Environmental Test Facility, pilots can be confident the aircraft—especially the engine—will function properly.

The two test cells housed in the facility, SL-2 and SL-3, are sea-level cells similar to those that were at the Naval Air Warfare Center Aircraft Division in Trenton, N.J., which closed as part of the 1993 Base Realignment and Closure Act. The cells, previously known as 1W and 2W in Trenton, were part of that infrastructure and could not be physically moved requiring the construction of a new facility at AEDC. The cell's capabilities were transferred to AEDC in late 1998.

The SL-2/SL-3 facility includes provisions for testing 30,000-pound thrust class engines at Mach 1.1 and temperatures ranging from minus 65 to 260 degrees Fahrenheit. A fuel conditioning system provides fuel over the same temperature range. Instrumentation and control systems are compatible with other AEDC turbine engine test cells.

Before Trenton closed, all of the U.S. military's capability for altitude testing of aircraft turbine engines existed either at Trenton or AEDC. This included test capabilities not duplicated anywhere else in the United States, such as salt spray environmental corrosion testing and sand and dust erosion testing.

The Navy was determined to preserve these capabilities in a test facility that was able to evaluate unique conditions posed by possible operating environments in a timeframe matching wartime demand. This facility emphasizes the need for ready access to these capabilities should an emergency arise.

Without the sea-level cells, engine programs, such as the F119 program for the F-22, would rely on existing cells which could be occupied and could not handle the additional testing workload.

"The addition of these test cells to AEDC's infrastructure provides multiple test capabilities, since the cells are not altitude test cells but do have RAM air capabilities for environmental testing," said Jeff Albro, AEDC F119 Program Manager. "The new facility will also be able to support engine endurance testing, either with sea-level engine inlet, or with process air from the Aeropropulsion Systems Test Facility."

The first test program, the F119 for the F-22 fighter, recently completed testing in SL-2. The article for the second program, also an F119 for the F-22, is currently being installed in the cell.

Looking ahead to initial production, it is of greater significance that the FX624 has aggressively accelerated the hot-time demonstration of the F119's capability and will achieve 106 percent of hot time and more than 100 percent of the altitude operating exposure in 4,350 total accumulated cycles of mission usage, the planned return to deport interval, by mid-June. This is a clear demonstration of the F119 engine's capability to achieve...test objectives and to provide a reliable and capable engine to the user.

Paul Hartman
Pratt and Whitney, F119 development manager

SL-2 and SL-3

Photo by Gary Barton

By: Darbie Sizemore, AEDC Public Affairs

First Test "Firsts" in SL-2

In addition to this being the first test conducted in the new facility, several other firsts were realized during the test program.

It was the first

- **use of the ETF Data Acquisition and Processing System for a classified test program**
- **ETF use of the "next generation" throttle and engine loading controllers**
- **ETF use of "mini CADDMAS" for vibration analysis on a sponsored test**
- **ETF use of DAT recorders for high speed, digitized data recording**
- **ETF use of a fiber-optic camera as the primary augmentor viewing system.**

Furthermore, the team reduced the time for thrust calibration from one hour to less than five minutes and the time for SL-RAM inlet duct changes from two shifts to a half shift.

The team demonstrated a repetitive engine installation within four days and removal within two days, a new plant operations method to provide higher supply pressures while maintaining a high supply temperature and an unplanned, in-cell engine tear down and rebuild capability.

They earned the second quarter 1999 AEDC Technical Achievement Award for the first customer sponsored test in SL-2. The group was a joint Sverdrup and Air Force team.

We subjected the development engine to extended periods at AEDC in worst case conditions to prove adequacy of the design and manufacturing process and resistance to high cycle fatigue. This testing extends our understanding of engine durability. Congratulations to the entire engine and AEDC teams for a very successful [test] period.

Brig. Gen. Michael Mushala
F-22 SPO

Gaining the new facility

The Trenton Transition project transferred unique national testing capabilities from the Naval Air Warfare Center—Aircraft Division, in Trenton, N.J., to AEDC.

The transition effort began in 1993 when legislation targeted the Trenton site for closure in support of the "reinvention" of the Department of Defense through the elimination of excess military infrastructure. It was completed in 1998 at a final cost of $88 million. Actual construction of the facilities began in July 1996 and was completed in November 1998.

The Trenton facility had been the Navy's center for turbine engine testing technology and expertise for 47 years.

Beginning with its commissioning in 1951, the facility was involved in nearly all engineering and manufacturing development of Navy engines.

"It was of utmost importance to the Navy to avoid losing Trenton's test capabilities—a scenario that could potentially cripple the nation's aircraft inventories should the need for an emergency test arise," said Jack Walters, AEDC department chief of aeropropulsion systems test division and a Navy employee. "For example, without Trenton's turbine engine testing capabilities, the performance and reliability of Navy aircraft such as the F-14 and F/A-18 could be impaired."

Transfering the facility

To facilitate the transfer, the Navy, Air Force, Army Corps of Engineers, the design firm Burns & McDonnell, the construction firm Hensel Phelps and Sverdrup developed a formal partner agreement.

The program's management and technical direction, combined with close partnering with customers, contributed to the achievement of all program objectives.

"The schedule was accomplished such that no Navy engine programs were negatively affected, and each of the test facilities relocated or constructed at AEDC embody the technical excellence demanded by the Navy's strict performance requirement," said Kent Lominac, AEDC Air Force project manager.

Navy officials targeted the large engine environmental turbine testing and small turbojet/turboshaft altitude engine testing capability for transfer to AEDC, with additional testing to be incorporated into exiting test cells.

In order to accommodate this additional workload, some of the Navy's test cells were physically relocated from Trenton to AEDC, while the remainder was reconstructed to supplement the existing AEDC test cell infrastructure.

Requirements

The Trenton Transition team developed functional and technical requirements for the $66 million transition of these two large engine test cells. The technical program was completed within cost and without impacting the Navy's critical test mission. Efforts resulting in cost savings of nearly $6.5 million, $2 million alone by using Air Force T-9 Test Cells from other Air Force BRAC-affected facilities were realized.

The AEDC portion of the transition program—536,000 manhours and $31 million over five years—represented more than 20 percent of AEDC's total annual facility modernization, improvement and repair budget. Accurate resource forecasting and budgeting required to successfully complete the projects were critical to avoid impacting AEDC's primary mission—testing the Air Force's state-of-the-art aircraft, engines and rockets. The project was completed within the estimated cost and within evolving schedule estimates.

Transition nucleus

A team—made up of a small cross-disciplinary dedicated project group from Sverdrup, the Air Force, Army Corps of Engineers and other contractors—formed the nucleus of the transition effort from the development of requirements to the checkout and activation of the new facilities.

The coordination of activities between all of the engineering and craft personnel and all of the organizations involved was one of the major challenges—and successes—of the Trenton Transition program.

"Commitment to partnership is fundamental to success of a program with such an aggressive schedule, especially with three branches of military services, both AEDC contractors, a design firm and a construction firm involved," said Keith Beck, Sverdrup program manager. "The model established was to focus on the right technical solution rather than the interests of any individual or organization."

Evolution of SL-2 and SL-3

Clockwise from top, officials break ground at AEDC on the site of the new facility in 1996. Construction begins and continues for the next 21 months. Center officials and other dignitaries attend a ribbon cutting ceremony in August 1998. The cells mark the culmination of a five-year relocation project of test capabilities from the Navy test facility at Trenton to AEDC.
(Photos by Eddie Wright, Gary Barton and David Housch)

F119 powered F-22 Raptor in flight (USAF photo)

The outstanding success of this initial program has been specifically acknowledged by Brig. Gen. Michael Mushala and Tom Farmer, the senior F-22/F119 program management for the Air Force and Pratt & Whitney. Another indication of the extremely high level of satisfaction is the scoring of 5.9 on the AEDC performance report by Jim Sweeney, ASC F119 test coordinator. All but one of the 12 technical and project management areas evaluated on that form received a perfect 6.0 score from the AFMC test sponsoring organization.

Jeff Albro
AEDC F119 program manager