

# Systems integration at work: Hamilton Sundstrand and the Boeing 787

## Background

In 2004, the Boeing Co. selected Hamilton Sundstrand to supply multiple systems on the company's new 787 Dreamliner.

## The airplane

The Boeing 787 Dreamliner is being developed by an international team of top aerospace companies led by Boeing at its Everett facility near Seattle, Wash.

The Boeing board of directors granted authority to offer the airplane for sale in late 2003. Program launch occurred in April 2004 with a record order from All-Nippon Airways. As of June, 58 customers from five continents have placed orders for nearly 900 airplanes, making this the most successful launch of a new commercial airplane in Boeing's history.

The 787 program opened its final assembly plant in Everett in 2007. First flight is expected by the end of 2009 with certification, delivery and entry into service occurring by the end of 2010.

The 787-8 Dreamliner will carry 210-250 passengers on routes of 7,650 to 8,200 nautical miles (14,200 to 15,200 kilometers), while the 787-9 Dreamliner will carry 250-290 passengers on routes of 8,000 to 8,500 nautical miles (14,800 to 15,750 kilometers). A third 787 family member, the 787-3 Dreamliner, will accommodate 290-330 passengers and be optimized for routes of 2,500 to 3,050 nautical miles (4,600 to 5,650 kilometers).

## Technology investment

Hamilton Sundstrand is investing heavily in the 787's development. The company's new Airplane Power System Integration Facility in Rockford, Illinois, USA, is playing a pivotal role in developing and testing multiple systems for the Dreamliner.

Through high-speed data links with Boeing and with other Hamilton Sundstrand facilities in Connecticut and California, the facility operates as a virtual workspace. Engineers thousands of miles apart now have the ability to test and verify systems in a real-time, collaborative environment, simplifying the aircraft development and certification process.

APSIF brings together all the actual hardware from Hamilton Sundstrand as well as from other 787 partners. Hamilton Sundstrand has completed nearly 20,000 hours of integration testing in the APSIF.

## 9 systems for the 787

### 1. Environmental Control System:

The ECS provides complete airplane thermal management – including cabin temperature management and control, fresh airflow, pressurization control, heating and cooling, galley chilling, and cargo and crew rest compartment temperature control. The system also includes liquid cooling for the Power Electronics Cooling (PECS), pack bay overheat protection, wheel well fire protection and windshield washer/wipers. The first electrically driven air cycle air-conditioning packs will have twice the efficiency of the 777 air-conditioning pack. The ECS will produce enough cooling to cool more than 25 typical New England homes.

### 2. Nitrogen Generation System:

The 787 is the first passenger aircraft designed with an integrated on-board NGS. The nitrogen generation system produces nitrogen-rich airflow to the fuel tanks to increase fuel tank safety. Hamilton Sundstrand produces the pack assembly, including the motor-driven compressors, and is teamed with Eaton (formerly FRHitemp) for the distribution system, and Carleton Life Support (a Cobham company) for the air separation modules.

**3. Auxiliary Power System:** The APS comprises the auxiliary power unit (APU), and the inlet, exhaust, control, and mounting hardware. The first all electric APU will be 50 percent quieter and have 10 percent lower emissions compared to the Boeing 767 APU.

**4. Electrical Power Generating and Start System:** The EPGSS generates and controls the electrical power on the airplane. The system also provides the APU and main engine start capability, and the motor controls are multiplexed to drive the cabin air compressors and electric motor pumps. The EPGSS comprises four main engine-mounted variable frequency starter generators and two APU-mounted auxiliary starter generators. It also includes eight common motor starter controllers, six generator control units and two bus power control units. The system will produce 1.450MW of electrical power – five times the power generation capacity of the 767 and enough to power 400 homes. This will be the first time a large turbofan engine has been started electronically, and the EPGSS provides key technologies that enable the 787 to be the first "more electric" airplane.

### 5. Remote Power Distribution System:

The RPDS is a network of distributed power controllers that connect all the lower power loads in the airplane to the main power busses. They provide on/off as well as protective functions, and are controlled over digital communications busses, eliminating the conventional circuit breaker interfaces overhead. There are 17 individual boxes located throughout the airplane.

### 6. Primary Power Distribution System:

Hamilton Sundstrand has the lead role in providing the PPDS, and is teamed with ECE (a Zodiac Company), and Nabtesco (formerly Teijin Seiki). ECE will provide five AC power panels that control and manage the 230VAC, 115VAC and 28VDC busses on the airplane. Nabtesco will provide two +/- 270 VDC power panels, and the motor control racks they are part of. The combined rack and panel houses the eight large motor controllers, the power conversion equipment, and provides cooling manifolds from the PECS system.

**7. Ram Air Turbine:** The RAT provides emergency power in the unlikely event of a dual engine failure. The RAT comprises a propeller that is deployed into the air stream from the wing fairing and powers a hydraulic pump to pressurize the center hydraulic channel, and a generator to power the essential electrical bus.

**8. Electric Motor Pump:** The EMP comprises four electrical motors that drive hydraulic pumps on a demand basis. The pumps are provided by Boeing (sourced from Parker) however Hamilton Sundstrand is responsible for assembly and integration of the pump, motor and the motor controller (part of the EPGSS package).

### 9. Fire Detection and Suppression System:

Hamilton Sundstrand's Kidde Aerospace & Defense unit provides the cargo and engine fire detection and suppression systems. The systems comprise smoke and fire detectors, fire suppression bottles and nozzles and associated controls.

Rolls-Royce also chose Hamilton Sundstrand to supply the gearbox system for its Trent 1000 engine being developed for the 787.

## Program value

The 787 program is expected to generate more than \$15 billion in revenue for Hamilton Sundstrand over the life of the program.

## Hamilton Sundstrand basics

With 2008 revenues of \$6.2 billion, Hamilton Sundstrand has its headquarters in Windsor Locks, Conn. Among the world's largest suppliers of technologically advanced aerospace and industrial products, the company designs, manufactures and services aerospace systems and provides integrated system solutions for commercial, regional, corporate and military aircraft. It also is a major supplier for international space programs.

Hamilton Sundstrand is a subsidiary of United Technologies Corp. (NYSE: UTX). Based in Hartford, Conn., UTC is a diversified company providing a broad range of high-technology products and support services to the aerospace and building systems industries.

Source: Hamilton Sundstrand