Le Bourget Retrospective

Now that "the dust has settled" on the Le Bourget Airport exposition center north of Paris, it is appropriate to take a retrospective on the 1987 Paris air show. Anyone who attended this year's show, the wettest in recent history, knows that the reference to "settling dust" probably is not the best figure of speech to describe the closing of the event, given the succession of rain storms that drenched the Paris region during the 10-day exposition. Paris '87 will be remembered by most show veterans for its highly prized umbrellas, improvised rain gear, mud-splattered clothing and ruined shoes.

But Paris '87 also will be remembered as the show that solidified this international exposition as the primary meeting ground for aerospace officials from around the world; a place to forge the cooperative and collaborative relationships that are the key to survival in the global marketplace of the 1990s and beyond. As in years past, the 1987 Paris air show had its highlights, disappointments and lighter moments. Some of the memorable vignettes included:

- An Italian air force crew that came startlingly close to becoming the first Paris air show serious crash statistic in many years when its Panavia Tornado pitched out of control from a low-level maneuver during the flight display practice session the day before the show opened. When the aircraft plummeted toward the ground and disappeared behind trees across the field from the flight line, observers tensed for the crash and then were astounded to see the aircraft reappear in a nose-high, ragged-edge-of-the-stall climb and recover. The Tornado crew was scratched from the show flying routine in keeping with the strict flight safety rules that have kept the show free of any serious accident in recent years.

- Excellent flight displays by a variety of aircraft as pilots flew high vertical maneuvers whenever the ceiling allowed and shifted to horizontal routines when the fog and storm clouds rolled in. Show attendees were treated to superb high-g routines by the Dassault-Breguet Rafale, Britain's experimental aircraft program (EAP) prototype, a USAF/General Dynamics F-16C and a Canadian air force/McDonnell Douglas CF-18. The CF-18 routine included impressive square-turn loops and slow flight segments. The flight program also featured the first public appearance of Airbus Industrie's new A320 twin-engine transport, the arrival and departure of a USAF/Rockwell International B-1B bomber, the Soviet An-124 large cargo aircraft and An-28 and An-74 STOL transports. Israel Aircraft Industries' Super Phantom improved-performance version of the McDonnell Douglas F-4 fitted with two Pratt & Whitney PW1120 engines provided a startling display of brute power in a series of vertical maneuvers and tight, high-G turns that were totally out of character for the aging F-4. During one especially soggy day, as pilots threaded their way among the rain showers, one air show wag remarked that the Claudius Dornier Seastar amphibian was the only aircraft that did not seem out of place in the air.

- Strong Soviet participation from the flight line to the static display ramp and the Soviet pavilion, which featured a full-scale mockup of the Mir space station. The appearance of the old standby An-124, enhanced by the An-25 and An-74, was counterbalanced by the diminutive Su-26M aerobatic aircraft from the P. O. Sukhoi design bureau. Soviet pilot Evgenij Frolov flew the Su-26 in one of the most aggressive routines of the show, primarily in the vertical plane, and threw in eye-popping outside turns and other negative-g maneuvers for good measure.

- Daily flight routines by a pilot flying a replica of the Spirit of St. Louis aircraft Charles Lindbergh flew from New York to Paris. The juxtaposition of the tiny Ryan monoplane, flying the crosswinds with steeply banked slips to landing, and the modern high-performance military aircraft and transports provided a graphic measure of how far aerospace technology has progressed in the last 60 years. Other memories of aviation's "golden era" were evoked when a four-member crew took off from Le Bourget on a round-the-world flight in a restored Lockheed Model 18 Lodestar and returned 88 hr. 48 min. later, bettering Howard Hughes' 1938 propeller driven aircraft record of 91 hr. 17 min. A modern round-the-world record for jet-powered aircraft was set earlier in the show by Allen Paulson, chairman and chief executive officer of Gulfstream Aerospace, and a four-man crew, who flew a Gulfstream 4 on a west-to-east circuit in 45 hr. 26 min.

- Fewer language differences at the Le Bourget show in recent years as English has emerged as the primary mother tongue of the aerospace world. But there still were occasions when lack of a common language or an unwillingness to use one caused communications failures. A Soviet press briefing held in the An-124 was being translated only into French when it was interrupted by requests for an English translation. A poll was taken and the majority requested English translations. After a discussion, the Soviets rejected the democratic approach and continued the briefing in Russian and French. Earlier, at a French industry briefing, an English-speaking journalist asked if he could pose a question in English. He was told he could, and did. The answer was given in French.

- Lengthy traffic jams in Paris and on the autoroutes leading to Le Bourget that made getting to and from the show a daily grind. Government and show officials and guests whose schedules could not tolerate traffic delays used French motorcycle police escorts who bullied their caravans through multiple lanes of bumper-to-bumper traffic using two-tone klaxons, whistles and, when needed, glove-fisted thumps on fenders, doors and hoods to move stubborn motorists aside.

- Highly visible French national security forces, including "flying bomb squads," cadres of K-9 teams with explosive-sniffing dogs, rooftop sharpshooters and gate watchers who did a superb job of screening all visitors with a minimum of effect on the flow of traffic into the show. The precautions almost caused an incident when the B-1B arrived. As the strategic bomber was being towed to the ramp, security police discovered several boxes in its parking spot. Unattended boxes, packages and briefcases are presumed to be dangerous in France and usually are carted off and blown up. Fortunately, before this was done to the boxes in the B-1 parking spot, it was determined that they contained the aircraft's support equipment.

Despite its foibles and minor problems, however, the 1987 Paris air show passed into history as a success for its promoters as well as its participants, visitors and guests. The true benefit of taking part in the Le Bourget exposition may not become evident for months or even years, and then may not be all that clear. Little actual business that can be measured in sales ever is accomplished at the show. The return on investment at Le Bourget has to be measured in terms of enhanced image, access to international markets and the forging of collaborative arrangements that are so critical to the exploitation of those markets.

DONALD E. FINK/Paris

AVIATION WEEK & SPACE TECHNOLOGY June 29, 1987 11
Soviets Developing Advanced Aircraft To Upgrade Civil, Military Air Fleets

Le Bourget—The Soviet Union is developing a series of new transports and helicopters, and is studying a range of future aircraft as part of a broad plan to upgrade its maturing technology base to modernize its civil and military aircraft products.

Soviet aircraft at the Paris air show this year included the Mi-34 light helicopter, the Antonov An-28 short-takeoff and landing twin-turboprop, the Sukhoi Su-26M business aircraft, and the An-124 heavy-lift transport.

An extensive scale model collection inside the Soviet pavilion provided details on several new aircraft under development or in various study/evaluation planes, including the single-engine Tupolev Tu-204 200-seat-class transport and Ilyushin Il-96-200 widebody, the Tu-154 180-seat, and the An-24 30-seat transport, and the Il-184 60-seat aircraft.

The An-24, which is analogous to the British Aerospace Advanced Turboprop (ATP) aircraft, is a scale model of a turboprop-powered version of the Ka-26 designated the Ka-151—also was displayed.

Petro V. Balabonov, head of the Antonov design bureau, said the new aircraft presented at Le Bourget and the concepts exhibited in the pavilion represent a measured program to modernize Soviet transport aircraft lines by incorporating advances in materials, manufacturing, and propulsion technology.

We are making progress in many areas, and we are working to increase our production technology and efficiency,” he said. “Our next generation of aircraft should have 20-25% composite materials. We will have more efficient engines, and a greater percentage of automation is being introduced in flight controls.”

One of the Antonov aircraft at Le Bourget was the An-24 twin-turboprop, which showed its short-field operating capabilities, including takeoffs and landings at 1,900 ft. The An-28, which is unimproved, is capable of operating at 300-meter-long (1,900 ft.) unsupervised runways with one engine out. Normal takeoff run is 265 meters (870 ft.).

Skis or floats can substitute for the landing gear when operations from water and snow are desired, said the Soviet pavilion.

Maximum takeoff weight is 6,500 kg. (14,100 lbs), and a maximum payload is 2,000 kg. (4,400 lbs). The cable is configured to accommodate 17 passengers, and cruising speed is 350 km/h.

In addition, the An-24 can be used for maintenance, delivery, and as an air ambulance.

The An-28 has a high-flying fixed landing gear, and is capable of operating at 300-meter-long (1,900 ft.) unsupervised runways with one engine out. Normal takeoff run is 265 meters (870 ft.). Skis or floats can substitute for the landing gear when operations from water and snow are desired, said the Soviet pavilion.

Maximum takeoff weight is 6,500 kg. (14,100 lbs), and a maximum payload is 2,000 kg. (4,400 lbs). The cable is configured to accommodate 17 passengers, and cruising speed is 350 km/h.

At the normal takeoff weight of 1,200 kg. (2,645 lbs), the Mi-34 has a maximum speed of 210 km/hr., a cruise speed of 180 km/hr., and a service ceiling of 4,500 meters (14,720 ft.). The Soviets said they were operating at a reduced maximum takeoff weight of 1,020 kg. (2,250 lbs.), but did not take part in the flying demonstrations. The Mi-34 was designed as a training and light aerial transport aircraft that also can be used for liaison missions and for patrol, Soviet officials said.

The Mi-34 is powered by two Zvezda M-14V-26 piston engines and an old but reliable powerplant, according to one Soviet engine—aircraft engineer—and plants are being made to replace it with a turboshaft engine.

At the normal takeoff weight of 1,200 kg. (2,645 lbs.), the Mi-34 has a maximum speed of 210 km/hr., a cruise speed of 180 km/hr., and a service ceiling of 4,500 meters (14,720 ft.). The Soviets said they were operating at a reduced maximum takeoff weight of 1,020 kg. (2,250 lbs.), with a 450-km. (280-mi.) range with a 90-kg. (200-lb.) payload, and 1,800-km. (1,100-mi.) range with 165 kg. (360-lb.) payload. The Mi-34 has an area behind the main four seats for cargo or passengers. Hover ceiling is 1,500 meters (4,900 ft.). Service ceiling is 4,500 meters (14,765 ft.).

Overall fuselage length is 8.7 meters (28 ft.), main rotor diameter is 10 meters (33 ft.), while the tail rotor diameter is 11.6 meters (38 ft.).

Soviet Tu-204 Transport Will Incorporate Advanced Cockpit

Cockpit of the 200-passenger-class, medium-range Soviet Tupolev Tu-204 transport will incorporate displays and systems similar to those in the latest generation of Western aircraft. A full-scale mockup of the two-crewmember cockpit, displayed at the Paris air show, includes an automatic flight control system panel at the center of instrument panel glare shield, two large full-color electronic flight instrument system (EFIS) cathode ray tube displays for each pilot, and additional ODF displays on the center panel for engine and systems instrumentation (left). A "dark cockpit" philosophy has been adopted, in which all backlit pushbutton on-off switches remain until their normal position for any given phase of flight operations. The pilot's electronic flight instruments (center) include attitude and other primary flight information on the left screen and a navigation/vertical situation indicator on the right screen. Center console (right) is less cluttered than those of previous Soviet transports, with dual performance management system control display units at the forward end of the console and communications/navigation systems control panel units farther aft on the console. The Tu-204 will be equipped with a three-channel digital flight control system, according to Soviet engineers, with a two-channel analog backup.
Soviet pavilion at the Paris air show included a prototype Mi-34 lightweight helicopter, which has been developed for pilot training, international sport helicopter competitions, and liaison/patrol missions (above). The Mi-34 was surrounded by scale models representing past, present and future Soviet aircraft and helicopter designs. One of the models was of the Kamov Ka-126 improved version of the Ka-26 (right). The Ka-126 is fitted with two turboturbine engines that replace the piston engines used on the Ka-26.

1.48 meters (4.8 ft.). Fuselage cross-section is 1.42 meters (4.6 ft.) at the widest point, while the landing skid width is 2.06 meters (6.75 ft.).

The Mi-34 on exhibit at the Soviet pavilion was surrounded by a number of scale models representing past and current Soviet aircraft, as well as new designs under development or evaluation.

Positioned in front of the Mi-34 was a model of a twin-engine short-haul aircraft with tail-mounted pusher propfan engines that is being evaluated by a special section in the Yakovlev design bureau, Soviet officials said. The aircraft is being sized to seat about 150 passengers.

Also shown was the Ilyushin II-114 turboprop aircraft under development for use on routes up to 1,000 km. (620 mi.).

A Soviet engineer said the II-114 is "our version of the [British Aerospace] Advanced Turboprop (ATP) transport," for which the Soviet Union had opened discussions with British Aerospace on licensed production (Avast Sept. 30, 1985, p. 33). A number of propeller configurations are under evaluation for the II-114, officials said. The model shown here was fitted with six-blade, single-row propellers. Maximum takeoff weight for the 60-passenger transport is 20,250 kg. (44,640 lb.), and maximum payload is set at 6,000 kg. (13,227 lb.). Wingspan is 30 meters (98 ft.).

First flights of two other aircraft represented here in model form—the Tupolev Tu-204 and II-96-300—are anticipated in 1988, according to Soviet civil transportation ministry managers.

Both the Tu-204 and II-96-300 are powered by 35,000-lb. DA-90A turbofan engines and are fitted with winglets. The Tu-204 will be configured for 214 passengers in an all-economy cabin layout or with 214 seats in a mixed-class layout. Runway length required for takeoff is 2,500 meters (8,200 ft.), and cruise speed has been set at 810-850 km./hr.

Two advanced aircraft concepts displayed in model form at the Soviet pavilion were an eight-engine transport equipped with a large central cargo pod, as well as a Mach 5, 300-passenger transport equipped with a double-delta wing and powered by six airbreathing engines. Soviet engineers at Le Bourget stressed that both models represent only initial concepts.
Soviets Offer Mir for Experiments, Commercial Space Processing

Le Bourget—The Soviet Union is offering commercial space processing and experiment capacity on board the Mir station, marking the latest expansion of space services it is offering on the international marketplace.

The availability of Mir for commercial processing and in-orbit experiments was outlined by Soviet space program officials attending the Paris air show, where a full-scale mockup of Mir was on display and open to visitors.

Valery V. Ignatov, chairman and general director of the V/O Licenzitorg licensing commercial organization, said the basic price for payloads flown on Mir is $15,000 per kg., although this price was said to be negotiable.

Soviet representatives from Licenzitorg and the Glavcosmos space organization distributed a “consumer’s guide,” which provided basic data concerning the installation and operation of foreign experiments/systems on Mir by the cosmonaut crew.

According to the guide, experimenters “shall not be admitted to prelaunch test sites, launch sites or the flight control center.”

The requirement for access in exceptional cases would be subject to separate negotiation, the Soviets said.

The consumer’s guide provided some details on installation of payloads on the Mir space station and its building-block modules.

Payloads brought to Mir will be carried by Soyuz TM manned spacecraft, by unmanned Progress resupply vehicles or on board the building-block modules themselves when they are launched. Maximum overall dimensions of the equipment are 600 mm. in diameter and 1,000 mm. long. The weights allowed for the hardware will be determined through individual agreements, the Soviets said.

“Handling of equipment by the Mir [cosmonaut crew] shall, as a rule, be limited to assembly operations, change of easily detachable elements and switch-on/switch-off operations,” the guide said. “As a rule, instruments shall have a ‘power on’ indicator.”

Hardware may be installed outside the Mir station, subject to negotiation of terms and conditions, Soviet officials said.

Installation of payloads/equipment inside Mir can be made on interior wall panels or at 228-mm.-dia. and 426-mm.-dia. portholes. Placement of equipment outside Mir is possible with clamps on handrails and on magnetic holders, which are positioned on the main station as well as the Kvant astrophysics and other building-block modules.

Commands to the payloads are provided by Mir’s onboard control system in the form of 200-millisecond impulses in the power supply.

Equipment and samples returned to Earth will have a maximum diameter of 200 mm. and a length not greater than 300 mm., according to the Soviets.

Materials processing can be performed with Soviet-built systems, or using equipment provided by the experimenter and qualified for spacecraft, according to Glavcosmos officials here.

Soviet systems available on a commercial-use basis are the Splav-2 crystal growth facility, the Zona zone melt facility and the Kashtan electrophoresis unit.

Paris Air Show Coverage

Coverage of the 37th Paris air show in this week’s issue was provided by an AVIATION WEEK & SPACE TECHNOLOGY team headed by Editor-in-Chief Donald E. Fink.

The team included Robert R. Ropelowski, managing editor; Jeffrey M. Lenorovitz, European editor; David A. Brown, London bureau chief; Keith F. Mordof, Bonn bureau chief; William B. Scott, senior engineering editor, and Stanley W. Kandebo, engineering editor.

Photography was by Robin Adshead, Bryan Thomson and Lenorovitz.
British Aerospace, McDonnell Douglas Will Propose New Harrier Version

Le Bourget—British Aerospace and McDonnell Douglas will propose jointly a new multimission, radar-equipped version of the AV-8B/GR.5 Advanced Harrier that could fulfill a variety of roles, including that of a maritime air defense aircraft to provide cover to ships where an aircraft carrier is not available or cannot be exposed in restricted waters.

Initial presentations will be to the U.S. Marine Corps and to potential international customers, including Spain, Brazil, Japan and Italy.

In addition to a radar, which would give the aircraft the capability of carrying the Hughes-Raytheon AIM-120 advanced medium-range air-to-air missile (AMRAAM), the new Harrier version also would have the uprated Rolls-Royce Pegasus 11-61 engine, which will have an installed thrust rating of about 23,000 lb.

This would permit the new Harrier version—which may be designated the Harrier 3—the capability of carrying 9,000 lb. of useful load, or a full 7,500 lb. fuel load and 1,500 lb. of armament.

This would give it a greater range/payload capability than the General Dynamics F-16 and about the same payload/range capability as the Panavia Tornado, according to Heinz Frick, British Aerospace chief project test pilot.

He said the Harrier was a much better air combat aircraft than was generally recognized. "The original Harrier was usually able to defeat conventional fighters the first time they met and the Harrier 2 regularly defeats the Harrier 1," he said.

Simultaneously with the decision to proceed with the new Harrier version, British Aerospace and Dowty Group of Britain have decided to jointly fund development of the Skyhook shipboard aircraft launch and landing system and expect to have a working demonstration model by year-end.

Radar is being considered for the Harrier are the Hughes APG-65, currently installed in the McDonnell Douglas/Navy F-18, and the Ferranti Blue Vixen, both of which are pulse-Doppler, multimode designs. The radar would give the Harrier a beyond-visual-range capability to go with its close-in dogfighting ability, McDonnell Douglas officials said. A decision on the radar to be used is expected before the end of July and the aircraft configuration is to be frozen in September.

The new Harrier version would make its first flight in mid-1989, if a development decision is reached soon, and would enter production in mid-1990.

In addition to the air defense role, the new Harrier version is being proposed as an efficient antisubmarine aircraft when equipped with sea-skimming missiles. The aircraft would be able to carry both the British Aerospace Sea Eagle and the McDonnell Douglas Harpoon.

Soviets Display Phobos Spacecraft Replica

Soviet Union last week exhibited at the Paris air show a full-scale replica, pictured above, of the Phobos spacecraft, which will be launched in July, 1988, to Mars and its moon Phobos. The Phobos is a new modular spacecraft design that will be used as the basis for future interplanetary missions by the Soviets. Phobos' hopping lander, which will descend to the surface of Phobos and hop to a number of sites, is the sphere/square truss structure that is visible at the upper left of the spacecraft. The three large spherical tanks at the bottom will carry propellant to inject the vehicle into Mars orbit, and then circularize it, after which the tanks will be discarded. Two antennas are shown, the cone-shaped omni antenna at the far right and the high-gain dish antenna on top of the spacecraft. The Soviets will launch two Phobos spacecraft in 1988 (AW&ST Oct. 20, 1986, p.97; Mar. 24, 1986, p.80). The first will fly within 50 meters of the surface of Phobos and drop two landers for extended studies of the Mars moon. If the first Phobos mission succeeds, the Soviets may redirect the second spacecraft to a second moon, Diemos.

General Dynamics to Fund 18 Commercial Atlas Centaurs

Washington—General Dynamics will use company funds to begin construction of 18 Atlas Centaurs that are being offered commercially to private and government satellite owners, Alan M. Lovelace, General Dynamics Space Systems Div. general manager, said last week.

General Dynamics has several reservations for commercial Atlas Centaurs from customers who have placed $100,000 deposits, but have not yet signed any firm contracts. Eutelsat has booked two reservations and other unnamed customers have made additional reservations, according to General Dynamics, which hopes to begin commercial launches in 1989.

The price of the commercial Atlas Centaurs will be less than $60 million each, which the company believes is competitive with other launchers, including foreign ones. General Dynamics said the price will include a guaranteed reflight in case of launch failure.

The company said it would commit $100 million to its commercial ELV program. The funds will be used to upgrade the Atlas Centaur production facility in San Diego and to develop a 4-meter fairing similar to one used on the European Ariane booster. The improvements will lower production costs for the launchers, the company said.

General Dynamics also has invested in long-lead items for the Atlas Centaur engines, avionics and other components with the vehicle's four main subcontracts.
China Tailors Exhibit to Pursue Military, Commuter Aircraft Markets

Le Bourget—China tailored its first showing of actual aircraft and missiles at the Paris air show last week to a survey of interest expressed at the Farnborough air show in Britain nine months ago.

China exhibited three aircraft and two missiles here and had two exhibition stands displaying models of a number of other missiles and aircraft. Displayed at the show, but not flown, were:

- FT-7 two-seat trainer version of the Soviet-designed MiG-21.
- A3C ground attack aircraft, also developed from an original Soviet design.
- Y-12, a 17-seat turboprop commuter transport powered by two Pratt & Whitney Canada PT6 engines.

Also displayed were two missiles, the FL-2 subsonic sea-skimming ship-to-ship missile and the infrared-guided PL-5B air-to-air missile.

“We brought the Y-12 because there was great interest in it at Farnborough,” Tang Xinfeng, executive vice president of the China National Aero-Technology Import & Export Corp. of Beijing, said.

The Y-12, which is in service with CAAC, the Chinese national airline, is in volume production in China, with 10 aircraft delivered to the airline. It is a high-wing design, similar to the de Havilland Canada Twin Otter. “We have not yet received Western certification for the Y-12,” Tang said. “We have been talking to the [British] Civil Aviation Authority and we hope to solve this problem in the coming year.”

Similarly, the FT-7 trainer version of the F-7 fighter was displayed at Paris because of the interest shown in the F-7 version during the Farnborough show. Tang said the Chinese brought the trainer version to show that they could provide a trainer capability along with the fighter, and to permit possible flight demonstrations before or after the show.

Due to high interest shown at Paris, he said, China would likely bring the F-8 2 supersonic fighter to the “next show.” He did not specify whether this would be Farnborough in 1985 or Paris in 1989. A large model of the F-8 2 dominated the indoor display at Paris this year.

The A3C ground attack aircraft was selected for display because of interest shown at Farnborough and because the Chinese wanted to demonstrate the aircraft’s modernized weapons system. The modernization is being done under contract by Aeritalia, Tang said.

The two missiles displayed were selected because they were the most advanced of their type produced in China, according to D. C. Li, an official of the China National Aero-Technology Import and Export Corp.

The PL-5B is an infrared-guided air-to-air missile with an off-boresight launch capability that is being developed to enable it to have a wider off-boresight launch angle. The missile has a microwave-activated proximity fuze and a new, larger warhead, Li said.

Li said the PL-5B had a longer acquisition range capability than the earlier PL-2A and was lighter. It is powered by a single-stage solid-propellant motor. Development work on the missile, which is in service with the Chinese air force, is continuing.

The FL-2 sea-skimming missile is the most advanced of three antiship missiles in service with the Chinese navy.

The FL-2 uses a solid-rocket sustainer motor, rather than the liquid-propellant motor used on the earlier FL-7. Both missiles can be launched from ship or shore, using a solid-rocket booster, or from aircraft. They are guided by a pre-set flight program that takes the missile to the area of the intended target, where an active radar assumes control for terminal guidance. The FL-7 and FL-1 missiles were shown in model form only.

Also shown in model form was a new
trainer aircraft in development, designated the L-9, which will be powered by a Garrett TFE731 turbofan engine. "We brought the model to the show to indicate that we intend to develop it," Tang said.

First flight is scheduled for about 1990, and the aircraft is being discussed with the Chinese air force. There is no production commitment.

Shown in artist's concept only was the proposed MPC-75, a 75-passenger ultra-high-bypass-powered aircraft being studied jointly by the Chinese and Messerschmitt-Boelkow-Blohm of West Germany. A feasibility study of the project is due for completion in September, Wang said. If the program goes ahead, the aircraft would be scheduled for certification in about 1995 and would enter service in China about a year later, Wang said.

Talks are under way with General Electric in the U.S. on powering the aircraft with two General Electric GE38 UHB engines.

**Le Bourget**—Garrett Turbine Engine Co. is field-testing a new carbon seal in its ATF-3 turbofan engine, attempting to solve persistent oil leak problems that have affected U.S. Coast Guard/Falcon Jet HU-25A operations over the last year, according to Garrett and Dassault-Breguet officials.

Earlier versions of the No. 1, 2 and 3 oil sump carbon seals have been responsible for in-flight engine shutdowns, excessive unscheduled maintenance and revised procedures that have plagued Coast Guard flight operations as well as commercial owners of the Dassault-Breguet/Falcon Jet Falcon 200 business aircraft. At least one Falcon 200 owner has indicated sufficient displeasure with the engine that he is actively trying to sell his aircraft.

The ATF-3 turbofan has had a turbulent history since being installed on the HU-25A, a modified, upgraded Falcon 20 devoted to Coast Guard maritime surveillance and search and rescue missions. During the aircraft's development phase, the ATF-3 evolved through a lengthy series of design changes before receiving final Federal Aviation Administration certification. According to one Dassault official, as many as 36 engines have been removed from HU-25 aircraft as a result of powerplant anomalies. Further, the current oil seal problem has forced the Coast Guard to adopt revised operating procedures when encountering oil pressure fluctuations in flight, ultimately cutting short some missions.

Dassault officials noted, though, that...

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**Lack of Proper Power Unit Delays USAF B-1B at Le Bourget**

USAF/Rockwell B-1B banks sharply immediately after takeoff from Le Bourget airport last week after being exhibited at the Paris air show for six days. The bomber departed approximately 24 hr. behind schedule after the auxiliary power units failed to operate, preventing engine start. French ground power units proved to be electrically incompatible, prompting the Air Force to fly a military-standard power cart to Le Bourget on a USAF/Lockheed C-141 from Rhein-Main AB, Germany.
Seven Nations Near Accord On Modular Standoff Weapons

Garrett has responded quickly and positively to ATF-3 problems, initiating interim procedures that have mitigated operational impacts on Coast Guard and commercial Falcon 200 users. While trying to correct the oil seal problem, for example, Garrett created a quick-response field team to travel anywhere in the world and repair a customer's engine as quickly as possible. Throughout the seal redesign and development phase, Garrett also maintained direct contact with Coast Guard and commercial operators, keeping them informed and soliciting feedback, according to J. Delance, Dassault's director of customer support.

When the ATF-3 was operated at cruise power settings, carbon seals subjected to high temperature and pressure reacted with lubricating oil to produce coke particles along the seal's edge. The hardened coke particles defeated the seal's ability to withstand high pressures, eventually allowing oil to bypass the seal. This leak produced cockpit indications of fluctuating oil pressure or, in some cases, complete loss of oil pressure. If pressure was only fluctuating, pilots typically reduced power settings, lowering internal temperatures until the coke washed away, allowing the seal to reseat, according to Garrett and Dassault officials.

Because formation of coke particles was caused by interaction of carbon seals with Mobil Jet 2 lubricating oil at high operating temperatures, Garrett advised operators to switch to Mobil 254. This more temperature-resistant oil reduced the incidence of leaks and pressure fluctuations, but did not totally eliminate formation of coke and hardening of the carbon seals.

Initially, Garrett determined that the carbon seals were showing excessive wear, particularly the No. 1 and 2 sump seals. This resulted in excessive oil consumption and unscheduled engine removals every 200-300 hr. of operation. The No. 1 and 2 seals—which comprised most of the seal problems—could be replaced fairly easily, but the No. 3 seal required removing the engine, according to Ned Dobak, manager of turbofan engines for Garrett.

Garrett has modified the oil sump seals several times, but the new configurations repeatedly failed to pass an FAA-dictated endurance run. The latest seal design passed the 150-hr. test early this month, and currently is being field-tested on a Garrett-operated Falcon 200. This evaluation is expected to finish by late July.

Depending on the outcome of these field tests and subsequent FAA review, Garrett could begin retrofitting the new seal design late this summer.

Le Bourget—Signing of a memorandum of understanding among the members of a seven-nation group to cooperate in developing a family of modular standoff weapons could occur this week following the resolution of conflicts within the group.

The memorandum will outline a basic working agreement between the U.S., United Kingdom, France, the Federal Republic of Germany, Canada, Italy and Spain on the development of a series of three modular standoff weapons.

Under the agreement, Canada and Spain each will contribute 10% toward program development costs, while the remaining countries each will contribute 16% of total costs. Three standoff weapon versions will be developed under the MSOW program:

- **Version A**—A submunitions dispensing weapon with a 30-50-km. range that would be used for missions such as area denial, runway cratering and attacking ground based-air defenses. This weapon has its roots in the low-cost powered dispenser (Lopod) program.
- **Version B**—A weapon capable of carrying submunitions or a single warhead that has a range of 185-600 km. (115-370 mi.). Missions for this weapon would include attack of rear echelon air bases, depots and static assets such as bridges. This program is a descendant of the long-range standoff missile program (LRSOM).
- **Version C**—A submunitions weapon with a 15-30-km. (9-18 mi.) range that would be used to attack armored columns.

About 30,000 of the weapons could be required by the seven nations, with about 50% of them needed by the U.S.

Teams for the program should be completed soon. It is expected that General Dynamics will participate in a group that will include France's Dornier, the U.K.'s Hunting Engineering, France's Aerospatiale, Canada's Garrett Manufacturing, Ltd., Spain's Insel, Italy's Agusta and also Brunswick of the U.S.

Another team is being formed and ultimately may include Rockwell International, British Aerospace, Matra of France, Messerschmitt-Boelkow-Blohm, Aeritalia, Bristol Aerospace of Canada and CASA.

Teledyne CEA, Garrett, Microturbro of France and others have expressed interest in the program. Teledyne and Microturbro recently agreed to cooperate on an MSOW powerplant. They also are offering several of each company's engines as interim powerplants if program timing requires weapons introduction before their MSOW engine candidate is completed.

If the MOU is signed before the end of the month, the request for proposals could be sent out in July and proposals submitted in November. Preliminary development could begin as early as next February, and the award of a 40-month, $140-million development program contract award could follow in March, 1988.
Avionics Companies Seek Greater Collaboration

Le Bourget—An objective of many nations to increase their technology base is reshaping the avionics/electronic systems segment of the aerospace industry in much the same way airframe manufacturing has shifted—toward increased international collaboration.

Major U.S. aerospace electronics and systems houses increasingly are seeking international partners or acquisitions as a means of participating in the world market for their products. Many of those attending the Paris air show here have reorganized their operations to accommodate this new way of doing business, often as much for survival as for market expansion.

Officials of major U.S. firms producing a full spectrum of electronic products unanimously acknowledged that joining forces with a foreign partner was becoming an essential part of their corporate strategy for international marketing. Particularly in Europe, collaboration is “the only game in town.” Joseph J. Campanella, executive vice president of Honeywell’s new Avionics Systems Business unit, said, “We don’t necessarily always prefer it, but [collaboration] is now a way of life, both in Europe and in our own military business.”

Other senior officials of Honeywell, which acquired Sperry’s avionics and defense systems units late last year, noted that this shift to increased collaboration was forcing U.S. firms to focus their development and marketing efforts on fewer areas as a means of maintaining a technologically superior edge. This has led to unprecedented joint efforts between traditional rivals, presenting managers with difficult decisions about sharing information with firms that may well use that data to compete with them later.

Mature Management

“It takes a very mature management team to balance the need for cooperation with a [foreign or domestic] partner—just to maintain a share of the market—against the need to protect its own technological position,” one U.S. marketing representative said.

Westinghouse is pursuing a variety of international collaborative efforts, including technology sharing/transfer arrangements, joint ventures and prime/subcontractor agreements as a way to remain competitive, particularly in the European radar and electronic countermeasures market. According to a Westinghouse official, the company is working with several northern European countries to “bring in technology” that would, in turn, give the company an opportunity to compete to supply radars for the European fighter aircraft (EFA) and Rafale programs. The company also is working with the People’s Republic of China to supply scalped-down Westinghouse APG-66 radar for Chinese and Pakistani MiG-series aircraft.

A major factor in international marketing of aerospace products in general is the economic differences between U.S. and foreign companies. “Banks in this country better get into this with us,” Jim Holthaus, marketing manager for Westinghouse’s Defense Avionics Div., said. “Banks in other countries often help finance foreign sales of aerospace equipment, but ours haven’t done the same with U.S. companies. This is a big disadvantage to us. The situation must change in order for us to stay competitive with foreign companies that do give this economic support to their aerospace industries.”

Growth Objective

ITT has combined all of its major defense subsidiaries into a single company designated the Defense Technology Corp. as a way to focus its growth objectives in the international and domestic defense markets. According to V.W. Souveroff, president and chief executive of the new unit, the company is actively seeking arrangements with international firms through joint ventures, traditional teaming on specific program proposals and by establishing a strengthened worldwide marketing network.

ITT has acknowledged that “technology exchange is the wave of the future,” he said, and collaboration in the defense electronics marketplace is a two-way street. While having a European partner is about the only way a U.S. company can hope to penetrate Western defense markets, European companies who want to bid on Defense Dept. contracts have the same kind of problems in this country.” Appropriate teaming agreements are essential in today’s international marketing, which is “a bit of an art,” Souveroff said. ITT “almost always” teams when marketing in Europe, Souveroff said, but finds that co-production arrangements typically are preferred in the Far East. Competition rather than collaboration still appears to predominate in the Middle East.

Rockwell International’s Collins Avionics Div. representatives agreed that collaborative ventures were essential in marketing most electronics equipment in Europe today. One of the largest suppliers of communications equipment in the world, Collins is able to sell off-the-shelf radios in these countries without a European partner, although other military defense equipment sales require collaboration and/or offset provisions. A Collins official said the company is having particular problems “breaking into Airbus” to have U.S. equipment provided as standard, although airlines purchasing these aircraft are specifying Collins communications and navigation suites.

One Collins marketing representative noted that U.S. airframe manufacturers, while complaining about the unfairness of subsidized European aircraft marketing advantages, are encouraging foreign avionics suppliers to bid for certain equipment traditionally supplied by U.S. firms.

European, Mid-Eastern and Asian avionics and defense systems manufacturers expressed similar views concerning collaboration with U.S. and Canadian partners, saying this was the only way to break into U.S. military and commercial markets. As a result, most of the major French and British aerospace electronics companies have joined forces with selected U.S. firms

Two Firms Vie For New Canadian Helicopter Program

Le Bourget—E.H. Industries’ EH101 and Aerospatiale’s AS332 M. 2 Super Puma are the helicopter platforms competing for Canada’s new shipborne aircraft (NSA) program.

The program has a requirement for up to about 40 helicopters to meet a Canadian mission for a ship-based anti-submarine/anti-ship warfare, surveillance and targeting aircraft. The helicopter will be based on Canadian frigates and destroyers.

The new helicopters will replace aging Sikorsky S-61 helicopters, which have received updates but still require replacement.

“A selection should be made this year for funding a development phase,” J.C. Mackay, Canadian assistant deputy industry minister, said. “The aircraft should be in service in the early 1990s.”

Participation so far has been company funded. McDonnell Douglas Helicopter dropped out after an initial consideration and Sikorsky Aircraft decided that the modifications necessary to compete in the program with the Seahawk could not be justified.

“Our cabin volume was too small for the Canadian mission equipment package,” Robert Zincora, Sikorsky president and chief executive officer, said. “Instead, we joined the EH101 team and we will assist with the integrated logistic support and provide technical consultation related to the mission package.”

Canadian industrial participation is an important aspect of the program, as well
as life cycle cost considerations, Mackay said.

"We will be buying the system to use for a long time, so maintainability and system upgrade features are important."

The request for proposals suggested that the bidder's program either not represent any significant investment for the government or show how additional funds if required could represent a business investment beyond this particular program, he said.

Other objectives include adding work experience from integrating a complex weapon system, adding to the industrial capacity and improving the economic base in regions that need work.

Canadair is Aerospatiale's main associate contractor. Aerospatiale is offering the latest version of the Super Puma, which includes a new main rotor, longer rotor blades and—for the Canadian application—an automatic tail and blade folding feature.

The Mk. 2's gross weight has been raised to about 20,900 lb. and will include twin forward landing gear and an under nose radome.

EHI, the joint Westland/Agusta-owned company, is offering its larger, three-engined EH101, with Bell- Textron of Canada as its main partner.

Bids have been under review since February and funding for a government-sponsored definition phase should be available before the end of the year. A development program is expected to be awarded in 1989.

E. H. Industries EH101 helicopter (above) is vying for the Canadian new shipborne aircraft (NSA) program. The EH101 features an advanced five-bladed main rotor and is powered by three General Electric T700-401 turboshaft engines. Aerospatiale AS332 Mk. 2 Super Puma equipped for the Canadian NSA mission is shown below. The new Super Puma version uses a Spheriflex main rotor hub design and longer main rotor blades. Canada has a requirement for about 40 NSA helicopters.

U.S. firms, recognizing that lucrative systems contracts could be awarded to foreign companies through these offset programs have opted to secure at least part of the award by teaming with viable foreign competitors.

Overall, most Paris air show avionics/electronics participants seemed to accept today's complex marketing environment as a given and were using the show as an opportunity to display their capabilities to potential buyers and prospective teammates. This thrust was particularly evident in the French displays.

Thomson-CSF Aerospace Group, a 15,400-employee firm that posted $1.42 billion in 1986 revenues, had secured a two-story building on the Le Bourget flightline to display its assortment of military and commercial products, including:

- Multimode, multifunction airborne digital radars for fighter aircraft.
- Integrated self-protection jamming systems.

- Forward-looking infrared pods for tactical aircraft.
- A holographic head-up display with a 30 × 20-deg. field of view.
- An obstacle avoidance millimeter-wave radar for helicopters or low-level tactical aircraft. The system is sensitive enough to detect cables across the flight path and provide a real-time, color-coded visual warning display.
- The Raphael TH, a side-looking radar mapping system with real-time data link to a ground-based processing station.
- Computer-generated visual systems for research and development simulators.
- A digital map display for fixed- and rotary-wing aircraft. The image can be presented as a normal plan view, three-dimensional plan view or pilot's perspective view.
- Ground-based air defense radars, air traffic control systems and a complete airborne antisubmarine warfare suite.

Another French company with a strong
PARIS AIR SHOW

General Electric Will Expand Collaborative Engine Programs

Le Bourget—General Electric will collaborate with Avco Lycoming Textor on aircraft and vehicular gas turbine engines, and with Bendix and Ruston Gas Turbes of England on aircraft engine programs. GE will also expand its collaborative CFE738 turbofan engine agreement with the Garrett Turbine Engine Co. to forming a new joint company called CFE. CFE will be headquartered in Phoenix, Ariz.

Under the agreement with Garrett, General Electric and Garrett will participate on a 50-50 basis on a civilian turbofan variant of the GE27. This engine has been designated the CFE738 (AWST June 15, p. 248). General Electric is responsible for core development of this engine and Garrett holds responsibility for the CFE738's low-pressure system.

CT7-3 Development

General Electric also is studying development of the CT7-3, a 1,500-1,600-shp, flat-rated derivative of the 1,870-shp, flat-rated CT7-9. No decision has been made to launch an engine development program, but the company is discussing the engine concept with airframe manufacturers.

The GE agreements with Avco Lycoming, Bendix and Ruston are for cooperation on core development for the turbofan CFE738. The three companies also will cooperate with GE on developing turboshaft and turboprop engines that will be used in the CFE738.

Garrett has no agreement with Avco Lycoming, Bendix or Ruston. All of their activities on the CFE738 core are covered by GE's 50% share in CFE Co. All of the privately funded derivatives of the GE27 will be designated the GE38 family engines.

Under the GE38 agreements, Avco Lycoming will be responsible for some compressor, hot section and structural pieces of the GE38/CFE738 engine family. Bendix will develop the full-authority digital electronic control for the engine family. Ruston Gas Turbes will develop and produce compressor hardware and turboprop/turboshaft power turbine parts.

Avco Lycoming also will participate in management of the turboshaft and turboprop engine programs through a joint program management office. The multi-company partnership is targeting the U.S. Navy's P-3 follow-on, the long-range ASW air capability aircraft (LRAACA), as the turboprop-derivative engine's first application. However, no final decision to launch the turboprop or turboshaft family of engines has been made.

The GE38/CFE738 family parent engine, the GE27, is being developed as part of the U.S. Army's modern technology demonstrator engine program. The GE27 core also may find an application in a production version of GE's unshrouded, ultrahigh bypass Unducted Fan engine.

The other General Electric small engine collaborative effort launched at the air show, the formation of the equal partnership CFE Co. with Garrett, will further formalize the joint venture engine program that began last year.

The CFE738 is aimed at 25,000-35,000-lb. gross takeoff weight business jets that will be available between 1991 and 2010. The company estimates this market at about 2,000 aircraft. GE is responsible for

ISC Developing Custom Standoff Weapon

Le Bourget—A large custom-designed standoff weapon is being developed by International Signal & Control Group (ISC) for use as a long-range ground attack system on the United Arab Emirates' Dassault-Breguet Mirage 2000 fighter aircraft.

The weapon could weigh as much as 1,000 kg. (2,200 lb.) depending on the specific configuration, and would be launched from one of the Mirage 2000's underwing hardpoints, according to Arab military officials attending the Paris air show here.

ISC, a U.S./U.K. aerospace equipment company, is developing the weapon as a customer-special project under terms of a multimillion-dollar order from the United Arab Emirates, the Arab officials said.

The United Arab Emirates was to have begun taking delivery of its Mirage 2000s this spring, but the transfer has been delayed because the country is not fully prepared to receive the aircraft. Arab officials said sufficient pilot training has not been completed, and other preparations necessary to handle and deploy the fighters need to be worked on.

The United Arab Emirates also has made a special order for electronic warfare equipment from Italy's Elettronica instead of the Thomson-CSF system normally used on the Mirage 2000. Elettronica is supplying the ELT/558 self-protection jammer system, which operates in the lower range of the radar frequency spectrum, and the ELT/158 radar warning receiver.
engine core development and Garrett will
develop the engine's low-pressure turbine
and fan. The engine has no customers yet,
but CFE expects that there may be a
launch customer by next year.

Derivative engine development also is
continuing to play an important role in
GE's plans, allowing the company to
stress the maturity of the basic engine
family while tailoring engines to meet spe-
cific market niches. One small engine un-
der study by General Electric is the
CT7-3, a 1,500-1,600-shp flat-rated turboshaft derivative of the CT7-9 engine. The
engine concept is being sized around the
emerging requirement for high-speed com-
muters, such as the Short Brothers/de Ha-
villand NRA-90 series. These aircraft will
be capable of carrying 19-30 passengers at
speeds in excess of 300 kt.

Power Needs Vary

According to General Electric, this type
of aircraft requires high power at altitude
to achieve necessary cruise performance.
However, the amount of power required at
takeoff will be less than that needed by
today's larger commuters because the new
aircraft will be smaller and lighter.
The power unit of the CT7-3—the area
from the engine inlet guide vanes through
the power turbine—would be identical to
that used on the CT7-9. The main change
is that the CT7-3 would incorporate an
integral gearbox, inlet and front frame as-
sembly that is about 125 lb. lighter than
CT7-9 components. The CT7-3 also
would incorporate a slightly reduced ex-
haust. Together, the front and rear reduc-
tions would make the CT7-3 about 26 in.
shorter than the 96-in.-long CT7-9.

A key marketing point of the program
will be engine maturity and reliability. Ac-
cording to GE, the CT7 engine family will
have accumulated about 2 million opera-
tional hours by the time an aircraft appli-
cation for the CT7-3 becomes available.

Derivative engines also are playing a
role in the engine manufacturer's large
engine programs. General Electric is de-
veloping a growth version of the CF6-80C2
for the Airbus A330 aircraft. With
France's Snecma, the partnership compa-
ny CFM is boosting the 25,000-lb.-thrust
CFM56-5A1 to 30,600 lb. thrust and be-
yond in the CFM56-5C-1. The engine will
be used on the Airbus A340 aircraft.

A memorandum of understanding with
Airbus requires GE to launch a 64,000-
ltb.-thrust engine for the A330 transport.
The engine offered by GE has been desig-
nated the CF6-80C2-A6 and it would be
certificated in June, 1992. The engine is
still under study, but the basic design
would be set by July, 1988, and the first
engine would go to test in late 1990.

General Electric will upgrade the CF6-
80C2 by making changes to the engine's
fan module. The engine core and low-
pressure turbine will remain common with
previous CF6-80C2 engines, but will in-
corporate product improvements.

Flow into the engine will be increased
10-15% by using wide-chord fan blades.
The engine's booster will be changed and
the outlet guide vanes will be changed to
match the increased airflow. The funda-
mental fan casing will remain unchanged.

The inner flow lines of the engine also
will be changed to accommodate the in-
creased flow, and will result in an inlet
lengthened by 1.36 in. The fan nozzle area
also will increase by 2 in. and the engine's
reverser cascade pattern may change to
ensure that sufficient reverse thrust can be
generated.

Thrust Improvements

GE also may use a long-duct mixed-
flow nacelle to improve specific fuel con-
sumption by 1-2%. The engine changes
should increase thrust to 64,000 lb., and
66,000 lb. of thrust probably could be
achieved using this same configuration.

The new fan module also could be ret-
rofitted to CF6-80C2 cores that have re-
ceived core improvements.

To upgrade the engine to 68,000 lb. of
thrust, changes would have to be made in
the turbine blade materials, low-pressure
turbine shaft and engine mounts.

On the CFM56-5A1, studies are being
made on how to upgrade the engine, and
design changes should be fixed by the end
of the year. CFM is examining increasing

the airflow of the engine so that it eventu-
ally may be able to generate 34,000-35,000
lb. of thrust. The company is examining
changes to the engine's fan, adding an
additional stage to the engine's booster,
changing nozzle area to accommodate the
extra air flow and increasing the cycle
pressure ratio from 29 to 33-35 (AW&ST
May 4, p. 44). The first of the upgraded
engines would go to test in late 1989 and
enter flight test in 1990. Engine certifica-
tion is planned for 1991.

Pratt & Whitney recently received
French and U.S. certification of its
PW4000 on the A310-300. The engine
was expected to enter service last week
on a Pan American World Airways Air-
bus A310-300.

Unshrouded ultrahigh bypass engines
also were represented at the show. The
Pratt & Whitney/Allison Model 578-DX
will begin static testing at Allison's Indo-
napolis facility by the end of the month,
and should begin flight tests on a McDon-
nell Douglas MD-80 by year-end.

General Electric is continuing flight test
of its Unducted Fan engine on an MD-80
based at Mojave, Calif.

A second UDF demonstrator engine
featuring a 10 x 8 blade configuration will
begin tests at GE's Peebles, Ohio, test
facility this month, and will be installed
on the MD-80 in July.

GE and its UDF partner, Snecma, also
are building components for a product de-
development engine that is expected to begin flight
test on a Boeing 727 in 1989. GE is con-
tinuing blade tests for this engine, and
Snecma has tested a combustor. The
French company also will begin test of a
high-pressure compressor soon.⁰