has brought back about half the span time," says Burbage, adding that further improvements are being sought.

From a general standpoint, the JSF team is also ensuring the F-35 avoids the pitfalls of earlier designs such as the F/A-18E/F and F/A-22. To avoid the lateral directional instability problems experienced by the F/A-18, with its wing drop phenomenon, all variants of the F-35 design will feature a simple, single leading-edge flap.

Similarly, the design team has spent a long time looking at high angle-of-attack (alpha) flow characteristics to see if the F-35 might be susceptible to the vertical tail buffet issues encountered by the F/A-18 and F/A-22. "It's a good thing we did that," says Burbage, adding that the windtunnel tests show the F-35 chine does indeed generate a strong vortex at high alpha, and that flight tests would have revealed a distinct tail buffet. Structural reinforcement is being designed into the aircraft's F-35 vertical fins as a result of the tests says Burbage. He adds: "We are bound to have enough of our own problems without repeating those of others."

Flying testbed

Avionics and sensor development and integration is being undertaken with two flying testbeds. One of Northrop Grumman's three BAC One-Eleven testbed aircraft is dedicated to F-35 systems testing and has been converted into a co-operative avionics testbed, or CATBird.

The aircraft will be used to give sensor fusion demonstrations to potential non-US JSF customer nations in a series of flights planned to take place from NAS Patuxent River, Maryland in January.

Although not in the original plan, Lockheed Martin has also opted to modify a Boeing 737-300 in Mojave, California for use as the prime F-35 CATBird. The aircraft is expected to begin flight tests with the full mission system on board in May 2005.

Sensors will include the nose-mounted Northrop Grumman active electronically scanned array (AESA) radar, the electro-optical distributed aperture system and electro-optical targeting system. A non-aerodynamic, fuselage-mounted canard will be used to replicate the positioning of sensor apertures and embedded antennas in relation to the AESA. The configuration will strongly resemble the 757-based airborne testbed developed for the F/A-22 programme.

Looking beyond the initial three main variants, Lockheed Martin is also preparing to tailor the F-35 more specifically to the requirements of the eight international industrial partners.

JSF teams plan to avoid wing drop and fin buffet issues that affected F/A-18 and F/A-22

As *Flight International* closed for press, the company was due to begin work under a newly signed "delta system" development and demonstration (SDD) contract designed to "incorporate the requirements from the international partners", says Burbage.

Apart from these delta SDD studies, conducted with the help of a Lockheed Martin Skunk Works advanced developments projects group, further customer-specific studies are also under way.

Although on a smaller scale than the mainstream delta SDD studies, the additional concept evaluations are expected to be important to the overall breadth and capability of the eventual F-35 family. One of these could be a two-seat design which Lockheed Martin says "was looked at in a preliminary way early on", and which is reportedly attracting interest from Israel.

Other longer-term variants studied briefly by Lockheed Martin, and expected to attract more interest, include a big-wing CTOL version with extended range and payload capability, and a conceptual electronic-warfare Wild Weasel variant concept for the US Marine Corps. ■

ability to market Typhoon internationally.

Lockheed Skunk Works reveals studies are under way for JSF microwave weapons.

Lockheed Martin says numbers of JSF bought by the USA are likely to fluctuate further, but will not affect overall programme outcomes.

General Electric and R-R reveal plans for an international F136 joint venture company.

Northrop Grumman announces JSF centre fuselage will be assembled at Palmdale, California.

JSF programme head Gen John Hudson says project is "truly a marriage between governments and industry". Confirms plans for creation of a security co-operation participation level to enable Israeli and Singaporean access to the programme.

Turkey formally joins programme as Level 3 partner, with investment of $175 million.

BAE Systems announces plans for £40 million investment in new JSF facilities in the UK.

The UK Ministry of Defence's investment approvals board meets to select a JSF version for future aircraft carrier, but is unable to make a decision.

Australian defence minister Robert Hill confirms interim fighter may be required by RAAF before JSF introduction.

AUGUST 2002

Lockheed Martin JSF team stages a series of technical briefings in Australia to support Australia's decision to join the programme.

TRW Aeronautical Systems (now Goodrich) selected by Northrop Grumman to supply weapons bay door drive system.

Astronics selected by Lockheed Martin to supply JSF exterior lighting.

Vought Aircraft Industries selected to supply JSF lower wing skins.

BAE Systems Controls delivers vehicle management computer development processors. This marks the programme's first avionics system sub-component delivery.

The UK MoD investment approvals board meets again to select a JSF version for future aircraft carrier.

SEPTEMBER 2002

Lockheed Martin reveals RAAF is considering requesting development of surveillance and reconnaissance variant.

The Australian defence minister defends JSF selection as the "most practical solution".

Israel's defence ministry accuses European JSF partner nations of blocking its attempt to join the programme with partner status.

General Dynamics selected to supply and integrate 27mm cannon for JSF.

The UK government announces plans to buy up to 150 JSF STOVL variants for the UK Royal Navy rather than the CV variant. Deal to be worth £10 billion.

OCTOBER 2002

American Institute of Aeronautics and Astronautics honours eight Lockheed Martin engineers for their contribution to JSF design.

JSF programme completes first year of SDD phase. Tom Burbage says the programme is on schedule and slightly under budget.

Israel makes last-ditch bid to join the programme with full partner status.