



Left Impact shears the left main gear and radome. The aircraft then bounces and enters a high-speed swerving skid, and leaves the runway after a few hundred metres (**centre**). Still at high speed, Gripen turns through 180° and the right wingtip digs in (**right**), causing the aircraft to flip over, coming to rest inverted

Software fault caused Gripen crash

by Mike Gaines,
Defence Editor

The crash of Sweden's first prototype Saab JAS39 Gripen fighter was caused by a flight-control software fault, the accident investigation committee concludes.

Committee chairman Olaf Forsberg confirms earlier assumptions that the flight control system was at fault for the February 2 landing accident. "The accident was caused by the aircraft experiencing increasing pitch oscillations (divergent dynamic instability) in the final stage of landing, the oscillations becoming uncontrollable. This was because movement of the stick in the pitch axis exceeded the values predicted when designing the

flight control system, whereby the stability margins were exceeded at the critical frequency," he says.

A separate investigation by the JAS Industry Group concludes: "The control laws implemented in the flight-control system's computer had deficiencies with respect to controlling the pitch axis at low speed. In this case, the pilot's control commands were subjected to such a delay that he was out of phase with the aircraft's motion. This caused uncontrollable pitch oscillations, which resulted in the aircraft hitting the runway in the final phase of the landing. JAS is now introducing the necessary modifications to the control laws."

The accident occurred as

Gripen, flown for the first time by Saab pilot Lars Radestrom, was landing after its sixth flight. On final the aircraft displayed a lack of stability, pitching down, then up markedly, then pitching down again to an angle from which it was not possible to recover before the aircraft hit the runway.

On its first five flights the aircraft had experienced problems with lateral oscillations, and on the sixth and last flight oscillation in pitch was also apparent.

Gripen first flew on December 9, some 18 months behind schedule. The delay was attributed to difficulties in proving the software for the flight control system developed by Lear Seigler (now GEC Astro-

tics). Gripen is naturally unstable and has a triplex digital fly-by-wire system with a triplex analogue backup. After the first flight, Saab chief test pilot Stig Holmstrom remarked that the control system seemed too sensitive and that the control laws would probably need to be changed.

Saab says it is still rescheduling its flight-test programme and re-distributing tasks between four remaining prototypes, which are still to fly. This, and modifications to the control laws, will take time, but the company hopes to fly JAS39-2 before the end of the year. Delivery of the first production aircraft to the Swedish Air Force is now expected in 1933, instead of 1992.

Second Hades success

France has successfully fired a second experimental Hades pre-strategic nuclear missile from the Landes test centre in south-west France outwards into the Atlantic Ocean, amid reports that the FFr15 billion (\$2.4 billion) programme hangs in the balance because of possible defence budget cuts.

The second firing occurred on March 8, following a first test on November 22 last year. On both occasions the 450km-range ground-to-ground ballistic missile was minus its 25 kiloton warhead. The Aérospatiale-built missile is due to replace France's existing Pluton weapon in 1992.

After the successful first firing, the French Army was keen to show Hades to French Prime Minister Michel Rocard during a tour of Canjeurs camp in southern France on March 2. Rocard instead chose not to see

the missile, and even hinted at possible cuts when the defence budget estimates come up for a review in Parliament next June.

French defence minister Jean-Pierre Chevenement threw his full weight behind the Hades programme, however, and on March 7 said it will go ahead as planned, although the Army may get fewer Hades.

Westland leads team

Westland Helicopters is leading a team studying avionics architectures for the next generation of light-attack helicopters.

The advanced avionic architecture and packaging (A3P) programme, sponsored by the UK Ministry of Defence, is looking at concepts which could be in place by the end of this century.

Westland is leading a team comprising Computing Devices, Logica, Plessey Avionics, and Racal Avionics studying fault and damage tolerant avionics built up from a limited set of common line replaceable modules.

The first, six-month, phase of the A3P study will consider all aspects of this approach, from functional requirements, resource sharing and re-allocation, failure detection and isolation, and data networking, to technology availability, including software and packaging techniques.

□ The prototype Westland 30 is exhibited at the **International Helicopter Museum** at Weston-super-Mare, Avon, in England, which opens to the public for the first time on March 24. The museum currently holds 38 rotorcraft and will add Westland's Lynx 3 prototype.

CASUALTIES

□ Greece

A Hellenic Air Force Lockheed T-33A Shooting Star crashed into rising ground north of Elefsis Airbase on March 7, killing both pilots. The Larissa-based T-33 was returning to its home base from Elefsis when it encountered bad weather. The aircraft crashed while trying

to turn back at low level.

□ United States

Two US Air Force General Dynamics F-16 Fighting Falcons collided over Cuenca Province, Spain, on March 14. One pilot was killed.

A US Air Force helicopter crashed in the Arizona desert during a night flight on March 12, killing all 15 on board.