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USA and CANADA

Head Office, Reed Business Publishing, 475 Park Avenue South, 2nd Floor, New York, NY 10016.
Telephone: +1 (212) 679 8888 Fax: +1 (212) 679 9455
West Coast, Reed Business Publishing, 3700 Campus Drive, Suite 203, Newport Beach, CA 92660.
Telephone: +1 (714) 756 1057 Telex: 238327 INTRA UR.
East Coast, Reed Business Publishing, Suite 204, 1321 Duke St, Alexandria, VA 22314, USA.
Telephone: +1 (703) 836 7444
Midwest/Canada, Reed Business Publishing, 411 Valencia Avenue, Suite 16, Barrington IL 60010-3341, USA.
Telephone: +1 (708) 304 5588 Fax: +1 (708) 304 9559.

FRANCE

Reed Business Publishing France, 15 bis, rue Ernest Renan, 92130 Issy-les-Moulineaux, France.
Telephone: +33 (1) 46 29 46 29

ITALY

Gruppo Editoriale Jackson, Via Gorki 69, Cinisello B Milano, Italy.
Telephone: +39 (2) 6603 4435 Fax: +39 (2) 6603 4367

JAPAN

Trademedia Japan Inc., Yamaji Sanbancho Bldg., 5th Floor, 5-24 Sanbancho, Chiyoda-ku, Tokyo 102, Japan.
Telephone: +81 (3) 3234 2161 Telex: J28208 MEDIAHS

SINGAPORE

Reed Asian Publishing (Pte) Ltd., 10 Anson Road, Hex 32-02 International Plaza, Singapore 0207.
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EDITORIAL

UK
 Editorial Enquiries +44 (81) 652 3842
 Editorial Fax +44 (81) 652 3840
 Editor Allan Winn +44 (81) 652 3882
 Editor's PA Barbara Raine +44 (81) 652 3882
 Deputy Editor Forbes Mutch +44 (81) 652 3852
 News Editor Andrew Chuter +44 (81) 652 3843
 Operations/Safety Editor +44 (81) 652 3845
 David Learmount

Business Editor Kevin O'Toole +44 (81) 652 3835
Commercial Aviation Editor Kieran Daly +44 (81) 652 3837
Defence Aviation Editor Douglas Barrie +44 (81) 652 3834
Aviation Research Editor Jennifer Pite +44 (81) 652 3847
Editorial Assistant Kate Sarsfield +44 (81) 652 3842
Production Editor Chris Thornton +44 (81) 652 3850
Design Editor Mike Wells +44 (81) 652 3828
Layout Sub-Editor Annabel Wells +44 (81) 652 3848
Technical Artist Tim Hall +44 (81) 652 8047
Technical Artist David Hatchard +44 (81) 652 8047
Technical Artist Giuseppe Picarella +44 (81) 652 8054
Spaceflight Correspondent Tim Furniss +44 (237) 451756
Photographer (Europe) Mark Wagner +44 (81) 944 5225

EUROPE/MIDDLE EAST
European Editor Julian Moxon +33 (1) 46 29 47 61
 [Fax +33 (1) 46 29 47 49]

Munich Correspondent Andrzej Jeziorski +49 (89) 689 1041
 [Fax +49 (89) 689 1045]

Paris Correspondent Gilbert Sedbon +33 (1) 48 25 52 61
Israel Correspondent Arie Egozi +972 (3) 967 1155
Moscow Correspondent +7 (095) 393 4717
 Alexander Velovich [Fax +7 (095) 393 4717]

AMERICAS
American Editor Graham Warwick +1 (404) 587 2927
 [Fax +1 (404) 594 1534]

Washington Correspondent Ramon Lopez +1 (703) 836 7443
 [Fax +1 (703) 836 8344]

West Coast Correspondent Guy Norris +1 (714) 252 8971
 [Fax +1 (714) 252 8972]

ASIA PACIFIC
Asian Editor (Singapore) Paul Lewis +65 226 3188
 [Fax +65 227 1769]

Australian Correspondent Paul Phelan +61 (70) 532 791
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Enquiries +44 (81) 661 6373
Classified USA Gail Tavelman +1 (212) 545 5403
Classified Asia/Pacific Karen Kwan +65 226 3188

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COMMENT

TIRED QUESTIONS

NASA has added fuel to the burning issue of airline pilot flight time limitations (FTLs) by claiming scientific evidence that maximum standard crew-duty times should be well below almost all existing national limits. In doing so, it has probably wrong-footed Europe's Joint Aviation Authorities (JAA) on a highly emotive subject.

Regulators tend to see FTLs as providing a means for improving safety through imposing maxima: some pilots seem to regard FTLs as being a means for airlines to increasingly exploit them, by effectively imposing minima. By questioning the JAA's controversial proposals, NASA may well be seen to be taking sides against the regulators.

One of the more surprising aspects of this debate is that — if the US Federal Aviation Administration is influenced by the latest NASA proposals — the USA could be heading for far more restrictive regulations than is Europe. Surprising, at least, to those who look on the European Union and the "Social Chapter" of its constitution as being obsessed with improving the lot of the employee at the expense of the employer, but perhaps not so surprising to those who look at the USA as a hot-bed of litigation.

If there is to be legislation, it would be to the benefit of all if it could be on a common international basis. There are, of course, wildly differing conditions applying in Europe and North America. Many US domestic flights are both longer and pass through more time zones than do the bulk of European international flights. The stress-drivers in the two environments may be very different — but the one environment is not necessarily any more stressful than the other.

Given that, it is difficult to see how — if the basis for recommending FTLs is scientific investigation — the recommendations from the two sides of the Atlantic can be so different. When NASA's full report is published, with all its data sources and reasoning made clear, the airline operators, pilot associations and regulators will have a duty to look carefully at what it says, and not to dismiss it as the

stuff of absent-minded scientists. It is the regulators who, in the end, have the responsibility for making the decisions — but they do have a duty to take into account years of actual line experience and others' investigative work.

There has always been something of a stand-off between operations people and specialists in the various branches of aviation medicine, and nowhere is this more obvious than on the issue of FTLs. The effects of tiredness and fatigue are difficult to quantify, and it is well known that people can perform apparently well (or at least adequately) in complex tasks after appallingly long periods of work and stress.

Just how well those tasks are performed, however, remains open to question. Nobody denies that

"pilot error" remains the most frequent primary or major factor in fatal and serious accidents. What is less-well understood is what part fatigue or tiredness may have played.

Accident reports always state the amount of time that the crew have been on duty for the flight concerned, and usually report their time-on-duty for the complete shift if it has been a multi-sector day for them. It is rarely reported how many duty hours have been worked in the previous week, fortnight, month and year.

Fatigue, as aviation physicians and psychologists define it, is a state where tiredness has reached the stage of degrading the efficiency of the human machine, like disease does. Regulations about FTLs, where they exist — and, unbelievably, they do not exist in some countries — have sought to control the disease, but without necessarily identifying just what the disease is. NASA's study is claimed to be scientific: if it is, and it calls into question much of existing practice, then it could indeed justify a major shake-up.

Publication of NASA's report has come at an inconvenient time for the JAA regulators, who are struggling to bring together this year the whole European Union's operations regulations into a common set of rules. NASA's findings could alter the whole basis of those proposals.



"Some pilots seem to regard FTLs as being a means for airlines to increasingly exploit them."



Pierson: no easy solutions

Airbus boss raises doubts over FLA

AIRBUS MANAGING director Jean Pierson has cast doubt on the ease with which the military Future Large Aircraft (FLA) programme can be integrated into Airbus Industrie.

The partner nations in the European military-transport aircraft want to place the programme on a "commercial basis" within Airbus to control costs, but Pierson says that agreement on how to do this has yet to be reached. "The situation is not clear at all. We don't have a consensus."

He adds: "The British are not among the partners who diverge the most over the best industrial scheme."

The implication is that the two main FLA partners, France and Germany, have differing agendas for the inclusion of FLA within Airbus. Italy, which is not an Airbus partner, is also a major participant in the transport programme. □

NEWS IN BRIEF

■ AIR MALAWI EXPANDS

Air Malawi is to receive a Boeing 747-300 and two 737-400s from Malaysia Air System. A Government statement does not reveal the airline's intentions for the aircraft.

■ BELL TAIWAN DEAL

Bell Helicopter Textron is to set up a helicopter-maintenance plant in Taiwan in collaboration with Air Asia.

NASA disputes JAA duty plan

DAVID LEARMOUNT/LONDON

EUROPEAN JOINT Aviation Authority (JAA) proposals for airline-pilot working hours exceed safe limits, with excessive duty time and inadequate rest periods, according to a study from NASA. The JAA has declined to comment.

The study was led by Mark Rosekind of NASA's Ames Research Center and Hans Wegmann of the German Aerospace Research Establishment's Institute of Aerospace Medicine. It does not single out regulations, but provides a scientific base on which to calculate safe duty times.

According to the proposed European Joint Aviation Regulation (JAR Ops 1 section Q) on Flight Time Limits (FTL), the maximum allowable extended crew-duty day for a three-sector route could run to 14h 30min.

The NASA report recommends

that, "...for standard operations, the cumulative flight-duty period [should] not exceed 10h within a 24h period. An extended cumulative flight-duty period would be limited to 12h. This limit is based upon scientific findings from a variety of sources, including data from aviation, that demonstrate a significantly increased vulnerability to performance-impairing fatigue after 12h."

The report adds: "It is readily acknowledged that in current practice, flight-duty periods extend to 14h in regular operations. However, the available scientific data supports a guideline different from current operational practice."

The proposed JAR FTL will allow an augmented crew to fly for more than 16h with up to three landings, provided that defined crew-rest facilities are on the aircraft. NASA's recommendations would reduce this 16h duty-time

trigger by 2h and allow for only one landing instead of three.

The new regulations, which are opposed by European pilots' unions, are to become law in 1997.

NASA's recommendations for minimum "recovery" periods are also more stringent than the JAA proposals, with a more direct relationship between the time worked and the recovery time required.

NASA says that, for rule-making, time-periods to which duty maxima apply should be "more frequent". For example, in addition to daily, weekly and monthly maxima, it says that there should also be fortnightly maxima to protect against the employer who might try to cram a month's duty time into two or three weeks.

The US Air Line Pilots Association and the International Federation of Airline Pilots Associations (IFALPA) support the NASA recommendation. □

Belgium holds bilateral talks with USA

KEVIN O'TOOLE/LONDON

BELGIUM AND THE USA met on 28 February to finalise the latest transatlantic open-skies agreement, so dealing another blow to European attempts to develop a common response to the US bilaterals offensive.

A Belgium deal would also allow Delta Air Lines, Sabena and Swissair to create the most far-reaching alliance yet formed across the Atlantic.

Further open-skies talks are scheduled to take place with Austria, Iceland and Luxembourg early in March and with Finland by the end of the month. No date has yet been set for joint Scandinavian talks with Denmark, Norway and Sweden.

If the deals are signed as scheduled, it will mark a significant victory for the USA in its strategy of opening up Europe's air market through small open-skies deals.

The European Commission (EC) has attempted to win powers to negotiate collectively on behalf of the European Union (EU), but efforts have been opposed by large



USA drives wedge into European bilateral ambitions with expected Belgian deal

er member states and airlines wary of handing powers to Brussels.

EU transport ministers are due to review the issue again on 14 March, but may now be faced with having to carry out a damage-limitation exercise. In a further development, UK negotiators are understood to have travelled to Washington on 21 February to reopen stalled talks on a new UK-US bilateral.

British Airways chairman Sir Colin Marshall has restated his opposition to collective EU bargaining, but supports the aim of "full open-skies arrangements"

with the USA and other trading blocs, based on a free market.

The Netherlands became the first to sign an open-skies agreement with the USA in 1993, so freeing KLM and Northwest Airlines effectively to operate like a single airline across the Atlantic.

A fresh drive by the US Department of Transport to open up Europe has already resulted in the signing of a Swiss deal in mid-February. Signing up Belgium could complete the picture, however, given Sabena's alliance talks with Swissair and its growing code-sharing relationship with Delta. □



USN F-18 contract lands Lucas with Pentagon problems

Lucas fights US defence ban over gearbox failures

KEVIN O'TOOLE/LONDON

LUCAS INDUSTRIES is preparing to fight attempts by the US Navy to bar it from competing for any future US military contracts. The UK group is also fighting on a second front to defend itself from an action for civil damages being brought against its Lucas Western and AUL defence operations.

The disputes stem from mid-1993 when evidence emerged that the two US subsidiaries had falsified inspection records on US defence contracts. The main contract was for Air Mounted Accessory Drive (AMAD) gearbox units supplied by

Lucas Western for US Navy McDonnell Douglas F-18s.

The complaints led to a criminal action, which was eventually settled in January, with Lucas agreeing to pay a \$18.5 million fine. The US Navy is still claiming damages for non-performance of the gearbox units.

Lucas believes that the latest threats to bar the group from further military work are "designed to bring maximum pressure to bear" on negotiations to settle the claims.

Lucas questions the legality of barring the whole group from bidding for defence contracts and the likely severity of the penalties given its rapid actions to correct the faults once they were uncovered. The group inherited many of the quality problems when it purchased the Lucas Western and AUL operations in the late 1980s.

Lucas also plays down the impact of any bar, pointing out that US defence contracts make up only around 3% of the group's overall \$4 billion turnover.

Lucas is also planning to fight the civil compensation claim now being brought through the US courts by a former Lucas Western employee, who was one of those dismissed when it emerged that quality procedures were not being followed.

The lawsuit is being filed under US "whistle blower" legislation, which allows an individual to bring an action in the name of the US Government against a company accused of wrongdoing. Lucas says that it plans to fight the action, claiming there is no evidence that the AMAD gearboxes have failed to perform adequately. □

An-70 investigators face FDR problems

KIERAN DALY/LONDON

THE INVESTIGATION of the fatal crash of the first and only Antonov An-70 prototype may be hampered by a lack of useable information from the flight-data recorder (FDR).

Sources close to the Antonov flight-test operation allege that pressure on staff to accelerate the flying programme led to the final flight being conducted without the FDR having been calibrated. Antonov has refused to comment on the allegations.

It is understood, however, that a video film exists of the aircraft's sudden departure from control, taken from the chase aircraft — now thought to have been an An-74 — which itself was nearly destroyed in the ensuing mid-air collision (*Flight International*, 22-28 February).

The sources — former Antonov flight-test engineering and piloting staff who remain closely connected with the Kiev-based operation — say that the An-70 suddenly veered sideways and the pilot was heard to transmit the words "yaw, yaw".

According to them, the flight-test staff were under intense pres-

sure to put more hours on the aircraft, despite numerous technical snags which, they say, created a high risk of an accident. The aircraft crashed two months after its first flight.

They allege that the An-70 first officer, who was also a qualified captain, had just been told that, once the flight on which he subsequently died was over, he was to be relieved of his position because of his repeated questioning of the technical risks being taken.

The faults are understood to have afflicted the fly-by-wire flight-control system and the aircraft's novel contra-rotating propellers. Failures in either system could potentially lead to the observed aircraft behaviour, although there is no confirmed evidence that these systems were actually at fault on the day.

Antonov has been urged by the Ukrainian Government to hurry the much-delayed programme because of its potential earning power and, in particular, because the Russian rival Tupolev-Tu 330 is in advanced development.

The design bureau is understood to hope now to use a static-test fuselage as the basis for another flying An-70. □

NEWS IN BRIEF

■ IN AND OUT CLUB

Greek flag carrier *Olympic Airways* has appointed Prof Rigas Doganis as its chairman and chief executive. Doganis is head of the department of air transport in the College of Aeronautics at Cranfield University in the UK. Embraer has appointed Juarez de Siqueira Britto Wanderley as president, following Ozires Silva's resignation. Wanderley is now senior vice-president for production at the Brazilian company. Andras Pahay, the chief executive at Hungarian airline *Malev*, has resigned. No successor has yet been named.

US Coast Guard ups Schweizer order

THE FIRST OF three Schweizer special-reconnaissance aircraft for the US Coast Guard (USCG) will undergo flight tests this month, six months later than previously planned, according to company officials.

Unofficially known as the SA 2-38/RG-8A Twin, the aircraft is a heavily modified version of Schweizer's SA 2-37A/RG-8A single-piston, two-place aircraft used by the USCG since 1988 for a range of missions, including search-and-rescue, patrol and counter-narcotics operations.

The original \$3.5 million contract called on Schweizer to modify two SA 2-37As operated from Miami, Florida, into more-capable, twin-engined aircraft, incor-

porating a push-pull engine combination with a twin tail-boom design similar to that of the Cessna 337.

The USCG, however, has found additional funds to buy a third, new aircraft.

The first modified aircraft will be ready in March for a flight-test programme, expected to last up to four months. The USCG could receive the initial SA 2-38 Twin in June.

The SA 2-38 Twin's crew consists of a pilot and a sensor operator. The USCG payload includes a forward-looking infra-red sensor, a television camera and AlliedSignal APN-215 weather radar, with search and surface-mapping modes. □

Flemings doubts add to Bravia problems

KEVIN O'TOOLE/LONDON

NEW CRACKS have appeared in the Bravia consortium, set up to sell Rolls-Royce re-engined Tupolev Tu-204 twin-jets, with the Flemings banking group expected to make a final decision over its involvement in the programme within weeks.

The problems centre on disputes over funding and certification delays which have dogged the relationship between Fleming Russian Investment (FRIC) and its two Russian Bravia partners, the Tupolev design bureau and the AviaStar production plant at Ulyanovsk.

The original plan was to have the Russian version of the aircraft certificated during 1992 with Aviadvigatel PS-90A engines, to be followed by a Westernised version with Rolls-Royce RB.211-

535 turbofans. Russian certification of the PS-90A-powered 204 was achieved only at the end of 1994, however.

"Our business plan was that the Tu-204 would be certificated by the end of 1992 and that we could start working on the Rolls-Royce version soon after. We invested in the belief that certification was imminent, but it was not," says Mark Jarvis, who heads FRIC in Moscow. He admits that funding for the programme has been halted for at least the past six months and there is little or no commercial activity on the programme.

The Russian partners have made increasingly acrimonious complaints over the lack of funding and support, which they believe should have been provided by FRIC. Tupolev and AviaStar remain confident that the certification of the Bravia aircraft will



Flemings halts funding to sell Westernised version of Tu-204

take place, but remain critical of FRIC. AviaStar says that the company does not see "much further business with Flemings", but adds that "...relations between AviaStar and Rolls-Royce are developing and improving".

R-R, which is not an official consortium partner, also says that it will stay with the programme. "We're continuing to support the flight-test programme and anticipate certification this year 1995," the company says.

A launch customer has yet to be found for the Bravia aircraft, despite a build-up of orders for the Russian version. The most likely prospects come from within the Russian airline industry, provided it can resolve present funding difficulties.

There has been speculation that Aeroflot is considering the Bravia Tu-204 as an option, but it could opt to lease Airbus A320s or Boeing 737s instead. Certification in the West is anyway likely to take at least another 18 months. □

Mesa places big Dash 8 order...

MESA AIR IS TO BUY 25 Bombardier de Havilland Dash 8-200s with 25 options in a deal which launches the model in the US market.

The -200 version is tailored for "hot-and-high" requirements and will be used by Mesa's Mountain

West Airlines division — a Denver-based United Express carrier flying throughout the Rocky Mountain area.

It is powered by two Pratt & Whitney Canada PW123D turboprops flat-rated to 1,600kW (2,150hp) at 45°C at sea level. □

...as Jetstream wins Air Atlantic

BITISH AEROSPACE'S Jetstream Aircraft division has sold ten Jetstream 41s to Air Atlantic — launching its latest product in Canada.

Jetstream says that the deal is worth about \$70 million and first delivery is due in March, with four

more following in the second quarter of the year and five more in 1997. It adds that the type replaces Air Atlantic's Bombardier de Havilland Dash 8-100s.

Air Atlantic is Canadian Airlines' code-share partner in Halifax, Nova Scotia. □

NEWS IN BRIEF

SELECT ADVICE ON ATC

A UK Parliamentary transport select committee report on air-traffic-control (ATC) privatisation is recommending that the Government publish detailed arguments as to why it does not favour the creation of a "profit-making public-sector company", instead of outright privatisation. It also recommends that, if the plan proceeds, the Civil Aviation Authority's safety-regulation group should be transferred to a separate body.

Gas leak led to Telstar 402 explosion

THE LOSS OF the Telstar 402 communications satellite after launch aboard an Ariane 4 on 8 September, 1994, was caused by an explosion, Martin Marietta Astro Space has confirmed (*Flight International*, 11-17 January).

Although the official accident report had not been released as *Flight International* went to press, the company admitted that the explosion "...occurred in the spacecraft-propulsion system and was caused when leaking hot gases from the firing of a pyrovalve reacted with hydrazine in the valve".

Nathan Lindsay, vice-president

of mission success and product assurance at Martin Marietta Astro Space says: "We're confident we've identified the root cause of the failure."

Over 50 realistic test firings of the pyrovalves have confirmed that excessive "blow-by" of combustion products is produced occasionally and will react with hydrazine.

"That explosion will rupture the fuel line," the company says, adding that the failure scenario matches conditions reconstructed from telemetry.

Two immediate recommendations have been made. The first is

to assure that a vacuum instead of hydrazine is present on the downstream side of the valve. Tests show that this will prevent an explosion if there is excessive blow-by.

The second recommendation is to change the pyrovalve to limit blow-up in the fraction of a second after the valve is fired.

"We are prepared to implement these recommendations and move forward with an aggressive plan for delivering spacecraft to our Series 7000 customers," says Russell McFall, vice-president of commercial programmes. □

Belgian scandal embroils NATO chief

HERMAN DE WULF/BRUSSELS

BELGIUM'S helicopter corruption scandal has claimed more victims. Three leading figures in the country's Socialist party have been arrested and NATO Secretary-General Willy Claes and European Commissioner Karel van Miert have become involved in investigations into the 1988 deal between the Belgian Government and Italian helicopter maker Agusta to equip the army with A.109s.

The arrests followed a search of the headquarters of the Belgian Socialist party in Brussels on 17 February. Three leading figures of the Flemish wing of the party have been arrested for allegedly illegally receiving BFr51 million (\$1.6 million) in connection with the deal. The scandal has widened to become one of the most serious in European aviation history.

Arrested were Etienne Mangé, Belgium's postmaster-general and treasurer of the Socialist party; Luc Wallyn, a European bureaucrat who was secretary-general of the Flemish Socialist party 1988; and Alphonse Puelinckx, a leading Brussels lawyer connected with the party. Also held was Georges Cywie, a businessman and former Agusta lobbyist in Belgium. Cywie had also been arrested in 1994 during an earlier stage of the investigation.

Three former Belgian socialist ministers were compelled to resign in 1994 over their alleged part in the affair after their parliamentary immunity had been lifted. Of the three, only transport minister Guy Coeme, who was the defence minister in 1988, faces trial charged with corruption.

The most important move so far is the Belgian justice department's announcement that it wants to interview Claes, who was minister for the economy at the time of the deal, and Van Miert, who was president of the Flemish socialist party around the time of the signing of the helicopter deal.

Claes initially denied any knowledge of the affair. He later admitted that he had heard of the alleged Agusta bribe, but told the party official involved that he did not



The root cause of the problem, the Agusta A.109

profit from an arms deal. The Belgian Supreme Court is preparing an official request to NATO to lift its secretary-general's diplomatic immunity to interrogate him.

In addition, procedures are also under way to lift the parliamentary immunity of Belgium's minis-

ter. Belgian investigators complied, after it had been verified that this could be done without breaking his diplomatic immunity as an EC official.

Van Miert had taken up his responsibility with the EC at the time of the helicopter contract and had left the party presidency to Vandeboucke, who at first denied having heard of the alleged Agusta illegal payment. Party treasurer Mangé insists that he informed top party officials.

The arrests result from investigations following the 18 July, 1991 murder of former Belgian minister André Cools in Liège. The investigation led to the discovery of a corruption scandal and of illegal financial transactions by the local branch of the Walloon socialist party.

With the aid of the Italian justice department, Agusta chief executive Roberto D'Alessandro was interviewed and the helicopter company's offices searched. The search uncovered documents apparently showing how much had been paid, and to whom, to ensure the signing of a BFr8 billion (\$255 million) contract for the sale of 46 A.109 helicopters for the Belgian army.

The Italian documents stated that a 0.25% commission had been legally paid to businessman Georges Cywie for his services as a lobbyist. The document also revealed the payment of a further

0.50% which has never been found. It is believed that the murder of Cools might be connected to this money.

According to Mauro Giallombardo, former secretary to Bettino Craxi, president of the Italian Partita Socialista Italiana (PSI), BFr15 million had been paid to Cools, but the money did not reach its destination. Giallombardo was in Brussels in the spring of 1989 and had contacts with André Spitaels (then president of the socialist party) and Claes (then minister of economics affairs).

The Agusta search revealed a document dated 10 November, 1988 — one month before the signing of the helicopter deal — stating that BFr51 million would be paid to a Swiss company known as Kamac if the deal with the Belgian Government progressed. Kamac's shareholders turned out to be Mohammed Bashi, a Syrian businessman, and Wallyn and Puelinckx.

The two men admitted receiving the money and said that the funds were intended for the financially hard-hit socialist party treasury. It has been established that the money was paid to Kamac.

Claes and Vandeboucke, while admitting they vaguely remember Mangé had mentioned the deal, claim that he acted on his own initiative. □



Van Miert: did they tell the president?

ter of foreign affairs, Frank Vandeboucke, and the Flemish socialist party president, Senator Louis Tobback.

Van Miert returned from holiday on the 18 February to say that he had nothing to do with the helicopter deal because he was no longer party president at the time. He publicly demanded that his home and EC office be searched —

Northwest is to spread out its Boeing deliveries

NORTHWEST will take delivery of 15 Boeing 757s earlier than scheduled, but will delay 25 more and possibly defer delivery of four 747-400s under an agreement with Boeing.

Under the pact, Northwest, which now operates 33 757-200s, will take delivery of the 15 additional 757s this year and in 1996, with the first arriving in October. They had been scheduled for shipment to Northwest in 1997 and 1998.

The next 25 757s, which were due to arrive between 1998 and 2000, will be delayed until 2003-5. The four 747-400s are on schedule for delivery in 1997 and 1998, but they may be deferred at Northwest's option.

Northwest agreed to accelerate 757 deliveries to "...smooth out and better time our schedule of new-aircraft deliveries". Boeing's Richard Albrecht says that the deal is good for both parties — Northwest achieves more flexibility and Boeing builds and delivers 15 aircraft sooner.

Northwest has obtained financing for the 15 757s. The 757 deferral and possible 747 deferral would save about \$2.4 billion in capital expenditures otherwise scheduled for 1995-9. The move saves the US carrier almost \$400 million in self-financed capital expenditures.

Early delivery of the 15 757s will allow the US carrier to retire Stage 2 Boeing 727s sooner. Northwest, meanwhile, says that it has converted options to purchase 40 JT8D hushkit shipsets made by ABS.

The move brings to 80 the number of McDonnell Douglas DC-9-30s it plans to hushkit. □

US airlines face FDR upgrade

GUY NORRIS/LOS ANGELES

US AIRLINES will be ordered to undertake major upgrades of flight-data recorders (FDRs) on more than 4,000 aircraft by the end of 1997 if the Federal Aviation Administration mandates a new recommendation from the National Transportation Safety Board (NTSB).

Upgrades on 739 of the US-registered Boeing 737s will have to be completed by December, with a further 3,588 aircraft in the US airline fleet having to be worked on by January 1998.

The NTSB says that present FDRs are "inadequate", and wants the minimum number of recorded data channels increased from six to cover 24 specific parameters. New-built aircraft would also have to meet improved FDR criteria, which the NTSB says will vary according to the aircraft type and

number of engines, but would cover "over 100 parameters".

Boeing 737s receive special treatment in the document because the NTSB blames FDR inadequacy for the mystery still surrounding the 1991 United Airlines 737-200 catastrophe at Colorado Springs, and the difficulty in finding a solution to the similar 1994 USAir 737-300 Pittsburgh crash.

Modern FDRs, points out the NTSB, are useable not just for crash investigation, but for fleet health and incident monitoring, suggesting that data on 737 fleet in-service control behaviour might provide clues which will help the Colorado Springs and Pittsburgh investigators.

The NTSB notes that 187 Boeing 737 flight-control incidents have been recorded between 1970 and 1994, 35 of them happening between 1990 and 1994.

As a result, the NTSB recommends that 737s with old FDRs should, by the end of this year, have the following parameters added to their existing recorder capability: lateral acceleration; and flight-control inputs and control-surface-position inputs for pitch, roll and yaw.

By 1 January, 1998, the NTSB recommendation says, Boeing 727s, Lockheed TriStars and all airliner types still in production should be fitted with FDRs with the capability of recording at least 24 specified parameters, which include the basic performance, control, aircraft attitude and engine parameters, plus other considerations such as autopilot engagement status, thrust-reverser position and angle of attack.

The FAA says that it "...fully supports the desire" to provide data which would help reveal accident causes. □

ERA claims charges were fatal for Euro Direct

THE EUROPEAN Regional Airlines Association (ERA) is holding up the demise of UK regional Euro Direct as an example of how airport charges are threatening smaller carriers.

Euro Direct was to have ceased operations by 26 February in a controlled fashion — promising to pay staff and creditors in full.

Chairman Neil Hansford, who arrived with a successful track record at TNT and British World Airways, says: "Even when you get

it right with superb employees, the European cost-burden does not allow a reasonable return on funds invested."

Hansford claims soaring handling fees at European airports were heavily responsible for Euro Direct's closure. A European Commission probe into airport-handling competition continues.

ERA says: "More and more major airports are moving from weight-related charges — which take into account seat-count and

passengers carried — toward peak charges which have increased costs disproportionately for smaller aircraft. There have also been general percentage increases and, at certain airports, we've seen hikes of up to 50% in the last five years.

"It adds up to over 50% of costs which are almost beyond control and being dictated by other people." The Bournemouth-based carrier had run British Aerospace ATP and J31 turboprops, but returned its ATPs in January. □

NEWS IN BRIEF

■ TRANSAVIA 737 ORDER

Dutch independent carrier Transavia Airlines is about to place an order for Boeing's new 737-700/800 family. The airline now operates four 737-200s and eight 737-300s, alongside three Boeing 757s.



Euro Direct handed back its ATPs in January

Lufthansa decides on A319 as successor to 737-200

ANDRZEJ JEZIORSKI/MUNICH

LUFTHANSA IS to order 20 Airbus A319 short- to medium-range airliners to replace its remaining Boeing 737-200s.

The airline says that it chose the latest and smallest product of the Airbus stable on "grounds of fleet policy and economics". The decision still requires the approval of the company's supervisory board in late March.

The airline has chosen CFM International's CFM56-5A turbofan to power the aircraft, in preference to International Aero Engines' V-2500. Lufthansa already has both engines in its fleet, and airline sources say that price was the key factor.

The aircraft will be configured to carry 126 passengers and be introduced into service between mid-1996 and late 1998, replacing the last 20 of Lufthansa's 737-

200s, which will be put up for sale.

Ten -200s were sold to Indonesia in 1994 and Lufthansa says that "definite interest" has recently arisen in the remaining 20 from an unspecified potential buyer.

The A319, like its larger stablemate the A321, will be assembled at Daimler-Benz Aerospace Airbus' (DAA) Hamburg site. Assembly of the first aircraft is to begin on 23 March, with the first flight due in September. □

South Africa drives J41 boost

JETSTREAM AIRCRAFT IS working on a fresh round of improvements for its J41, aimed at increasing hot and high performance for airfields in countries with developing infrastructures.

From 1996 the aircraft will be offered with a 2.2% increase in engine power, revised stall speeds and the introduction of a 9° landing-flap setting. The aim is to bring significant improvements in landing and take-off weight.

Marketing director Nick

Godwin says that competition for the South African regional SA Airlink order helped to focus Jetstream on the enhancements, eventually winning the deal for nine J41s in December. The flap-setting and stall-speed improvements are being flown on a test aircraft in South Africa.

A water methanol system and 35° landing flap setting will also be offered as optional extras to improve J41 performance in extreme hot and high conditions. □

Marshall wins second order for TriStar freighter work

MARSHALL AEROSPACE of the UK is to convert three Lockheed L-1011-200 TriStars to freighters for International Air Leases (IAL), and the company has also negotiated additional options.

The deal is the second major TriStar freight-conversion contract for Marshall, which again beat rival Lockheed Aeronautical Services (LAS) for the work.

It expects to receive its US Federal Aviation Administration supplementary type certificate for the converted aircraft in June.

The first IAL aircraft is due for delivery in November and the second and third in February 1996. IAL bought four of Gulf Air's eight TriStars, but Marshall is not revealing the number of options it placed, beyond noting that they run through to the end of 1997.

LAS is still seeking a launch customer for its own TriStar 2000 freight-conversion programme.

Marshall's first customer was American International Airlines — formerly called Connie Kalitta — which ordered the conversion of four ex-British Airways aircraft and then confirmed four options. □

Aer Lingus close to finalising deal to lease three BAe 146-300s

KEVIN O'TOOLE/LONDON

AER LINGUS IS close to completing a deal to lease three British Aerospace 146-300 regional-jets to allow it to compete on routes between Ireland and UK regional airports.

The aircraft are being made ready for leasing by BAe's Asset Management Organisation, although Aer Lingus declines to comment on the matter.

The three aircraft would replace turboprops on services between Dublin and UK regional airports serving Birmingham, Glasgow and Manchester.

Aer Lingus has been forced to consider upgrading to the 146 because its competitors are using jet-powered aircraft — particularly Ryanair, which is equipped with Boeing 737-200s.

Although the total passenger traffic on the routes has virtually doubled because of the growing competition, Aer Lingus is keen to maintain its market share.

The airline reports that 5,000 passengers a month are flying on the services.

A key part of its recovery strategy is the feeding of UK provincial traffic on to its revamped transatlantic services, flown direct from Dublin with Airbus A330s.

Aer Lingus has been reluctant to confirm its regional-jet plans, partly because of concerns over the European Commission's (EC) reaction.

The EC placed capacity constraints on Aer Lingus as one of the conditions for approving an injection of state-aid from the Irish Government in 1994.

Technically, the new regional-jets will replace rather than increase capacity, but Aer Lingus remains cautious.

In 1992, the airline was fined for refusing to interline with UK carrier British Midland, and in early 1994 it was the subject of a swoop by EC investigators after allegations of uncompetitive pricing had been made. □



Arctic cold thaws A340/777 relations

THE ICY RELATIONS BETWEEN Airbus and Boeing thawed a little recently when the Boeing 777 and Airbus A340 came face-to-face for the first time at Fairbanks Airport in Alaska. The Pratt & Whitney PW4084-powered 777, in United Airlines colours, was undergoing cold-soak and cold-weather flight-testing, while its European rival was seeking a -35°C overnight cold soak required for Canadian certification of the type, before deliveries can start to Air Canada later this year. Airport staff say that after an initial freeze-off, both sides checked out each other's hardware. Each manufacturer went home happy as the mercury dipped to -44°C during their visit.

DESTINATIONS

■ MALAYSIA AIRLINES

Malaysia Airlines will commence weekly flights from Kuala Lumpur to the Australian town of Cairns, via Darwin, on April 3. The operation is likely to be the first scheduled service to Australia using Airbus A330s.

■ USAIR

USAir has introduced a daily non-stop service between Pittsburgh and Mexico City. USAir is the only carrier serving Mexico City non-stop from Pittsburgh. It will also provide a daily non-stop service to Frankfurt from Boston and Philadelphia, beginning on 11 June.

■ AIR MALTA

Air Malta is launching a weekly service to Copenhagen following the success of its Stockholm and Oslo routes begun in 1994.

■ GB AIRWAYS

GB Airways, now a British Airways franchise carrier, is adding four-a-week services to the Spanish destinations of Valencia and Murcia in the northern summer.

■ AIR FRANCE

Air France's summer programme includes the dropping of Windhoek, Bahrain, Doha, Khartoum, Lima, Recife, Quito, Auckland, Colombo, Karachi, Glasgow, and Bari, Italy. Capacity is being introduced or increased on many routes, including those to South Africa, west Africa, the Middle East, Japan, Hong Kong, Bangkok, Singapore, Beijing, Seoul, Ho Chi Minh City, Taipei and Manila. In the Americas, services to Los Angeles, Mexico City, Buenos Aires, Sao Paulo and Rio de Janeiro are being increased. In Europe there are similar boosts on routes to Barcelona, Berlin, Rome, Stockholm, and Venice. Provincial French international services are also stepped up.



Vietnam Airlines plans to lease an A340, but needs nine 150-seat craft, too

Vietnam Airlines to lease Region A340

VIETNAM AIRLINES is negotiating to lease an Airbus A340 from Region Air of Singapore, in addition to its more immediate requirement for up to nine replacement 150-seat aircraft for its wet-leased Airbus A320s.

Region Air is understood to have already ordered one A340 and is considering the purchase of a second widebody, in anticipation of leasing the aircraft to Vietnam Airlines.

The latter airline says that it has a requirement for between four and five long-range widebody aircraft from 1996 onwards, but is short of funding. In addition to the A340, Vietnam Airlines has also been considering the Boeing 747 and McDonnell Douglas (MDC) MD-11 (*Flight International*, 22-28 February).

MDC chairman John McDonnell, meanwhile, has offered Vietnam 100% financing on any

aircraft it purchases from the company. The proposal was reportedly made during a meeting between McDonnell and Vietnamese premier Vo Van Kiet on 17 February.

The MDC MD-80/90 is offered against the A320 and Boeing 737 as a replacement for Vietnam Airlines's seven wet-leased A320s, due to be returned to owner Air France. The carrier wants to acquire up to nine aircraft on a lease-purchase basis.

Vietnam Airlines is understood to favour Region Air's offer of additional A320s, powered by International Aero Engines V2500 turbofans. Other competing leasing companies include International Lease Finance and General Electric Capital.

The carrier would like one or two more Boeing 767s. It already operates three 767s, two of which are leased from Ansett (AWAS) and one from Region Air. □

MAS seeks long-range aircraft

MALAYSIA AIRLINES (MAS) has asked for proposals from manufacturers for up to six new long-range passenger aircraft to replace its McDonnell Douglas (MDC) DC-10-30 on thin international routes.

Under consideration for the deal are the Airbus A340, Boeing 777 and MDC MD-11. The airline is understood to want the first aircraft to enter service in 1996.

MAS, in the meantime, has taken delivery of its first Pratt &

Whitney PW4168 turbofan-powered A330 twinjet, six months after the aircraft was due to enter service. Deliveries were initially held up by a delamination problem with the aircraft's thruster-reverser cowlings and the loss of a test aircraft. Four had already been completed and were parked in Toulouse.

The airline will take delivery of five A330s by the end of March. Five more are due to enter service by the end of 1995. □

Bidders line up for \$300 million UK ATC centre

KIERAN DALY/MAASTRICHT

HUGHES AIRCRAFT has become the first company to detail its planned consortium to bid to develop and build the UK's proposed Scottish Air Traffic Control Centre.

The UK Civil Aviation Authority's National Air Traffic Services (NATS) is expected to release a request for proposals to address the \$300 million requirement in the second half of this year.

It hopes to award a contract by the end of the year, although the potential bidders express scepticism over that timetable — one suggesting that a mid-1996 award is more likely.

The deal, one of the biggest air-traffic-control (ATC) prizes on offer, is controversial in the UK as it was to have been funded by industry under the Government's NATS-privatisation plan.

NATS has conceded reluctantly that, after the delay of the privatisation, it will have to use the Government's Private Finance Initiative (PFI) mechanism, under which it will lease the centre from the private sector. Senior CAA officials are determined to stave off further use of PFIs, however, while welcoming the privatisation plan.

The chosen technique means that the bidders are likely to form relationships with merchant banks to arrange finance, and will need construction partners.

At the ATC '95 exhibition in Maastricht, on 21-23 February, Hughes Europe manager of ATC business development Tom Harvey revealed that Hughes' team includes Hambros Bank, alongside ATC-requirements-expert Praxis, ATC-provider Serco-IAL and Laing Construction.

Others interested include Loral, Thomson-CSF and Trafalgar House of the UK. Raytheon is not bidding, believing it is understood, that Loral, owner of the former IBM Federal Systems Group, will be difficult to beat. IBM developed the New En-route Centre for NATS and has been a major supplier at London's Drayton Centre. □

UK prepares to impose TCAS II

DAVID LEARMOUNT/LONDON

THE UK IS TO BE the first European country to demand the use of traffic-alert and collision-avoidance systems (TCAS) in its own airspace. The UK Civil Aviation Authority says that it expects to give the go-ahead "within a matter of weeks".

The CAA says "Our research and operational studies show that TCAS II does provide a useful safety net against mid-air collisions. Under perfect conditions, TCAS II collision-avoidance logic can reduce the risk of collision by about eight times."

TCAS II is the version which provides the pilot with a "resolution advisory" [RA] instruction

[action to take], as well as a relative traffic position/vector display.

An implementation date for UK TCAS is expected to be set at the same time as the go-ahead decision - making it the first Eurocontrol and European Civil Aviation Conference (ECAC) country to follow the US lead.

A Eurocontrol task force will report on the issue of general airborne collision-avoidance systems (ACAS), not necessarily TCAS, later this year. Its chairman, Richard Jenyns, says that early indications are that use of ACAS would improve safety.

Officially, the CAA says that, given the continuing work to improve the system, it hopes that Eurocontrol will sanction a TCAS

II implementation policy for ECAC airspace.

The CAA study is continuing in conjunction with the UK Defence Research Agency, which has a BAC One-Eleven flying laboratory fitted with an AlliedSignal CAS-81 TCAS II. The CAA says that the intention is to work with the US Federal Aviation Administration and the avionics manufacturers to upgrade the US-mandated 604A software-standard TCAS II to a new level, known as version 7, by late 1997.

The improvements towards version 7, says AlliedSignal senior programme manager (TCAS) Tom Mullinix, will include:

- introduction of a horizontal miss-distance filter to reduce con-

flict-alert warnings — the CAA says that, particularly with fast-moving aircraft such as military types, the RA can be triggered with traffic 5nm (9km) distant, and even with traffic diverging;

- improvement to interference-limiting algorithms;

- software logic extension to enable TCAS to cope with the situation where a pilot carries out evasive action contrary to the RA (it cannot now cope with this);

- improvement to multiple-aircraft logic;

- real-time RA downlink to air-traffic controllers, to pre-empt possible confusion over potentially conflicting advice from the ATC display short-term conflict-alert system. □



Mesa Air now operates 78 Beech 1900D airliners

Beech boosts 1900D production

RAYTHEON AIRCRAFT is to increase production of Beech 1900D 19-seater airliners in 1995 to meet a surge in orders.

The company is expected to raise its annual output to around 55 aircraft this year, compared to 50 in 1994 and 45 the previous year. Raytheon declines to be specific about production numbers, saying only that the planned rise "...is in that order of magnitude."

The decision follows a spate of 87 orders in 1994, including a massive repeat order for 40 from US regional Mesa Airlines, which now operates 78 of the type.

The 1900D was developed from the Beech 1900 airliner, of which about 240 are now in service. Almost 130 1900Ds have been delivered and the order backlog is now thought to be just over 100. □

JAL and Thai consider expanding ties

JAPAN AIRLINES (JAL) and Thai Airways International are considering expanding their recently concluded co-operation agreement into a wider strategic tie-up covering Asia and the Indian subcontinent.

The two airlines have agreed to increase joint flights from Bangkok to Nagoya and Fukuoka, introduce

new joint services to Kansai Airport and develop co-operative marketing and business plans. These initiatives will begin in November.

JAL and Thai may extend this to include code-sharing and the joint use of Bangkok as a regional hub. Co-operation will also encompass passenger and cargo handling, catering and maintenance. □

China forces Israel to freeze Taiwan project

PRESSURE FROM CHINA has led to Israel freezing talks about the establishment of a joint maintenance centre with Taiwanese industrial interests.

The talks, which started in 1993, had advanced to the point where Israel Aircraft Industries (IAI) had signed a memorandum of understanding with a group of Taiwanese companies, headed by the Kwang Hwa holding company.

Under the plan, IAI was to supply know-how for a \$160 million centre about to be built to maintain civil aircraft and various military aircraft operated by the Taiwanese air force.

The Chinese Government, which opposes any type of military assistance to Taiwan, reacted when the talks reached an advanced stage in late 1994 and asked the Israeli Government to instruct IAI to freeze further negotiations.

Israel, which has been heavily involved in the supply of military equipment to China, opted against harming its relations with Beijing and has instructed IAI not to conclude the deal.

IAI says that the talks have not resulted so far in a contract and that "negotiations continue". □

MAINTENANCE

FINNAIR MAINTENANCE

In the production of our *Airline Maintenance Directory* (15-21 February), the country header for Finland and the entry for Finnair were unfortunately omitted.

The details for Finnair are as follows:

FINNAIR, Helsinki-Vantaa Airport, 01530 Vantaa. Tel: +358 (0) 818 81; fax: +358 (0) 818 6900; telex: 121548.

Airframe engineers: 100+.

Engine engineers: 100+.

Avionics engineers: 100+.

Speciality:

airframes/engines.

Approvals: CAA, FAA, JAR.

Principal makes serviced:

MDC DC-10-30, MD-11,

DC-9, MD-80, Saab 340,

ATR 42, 72.

Widebody space: 8.

Narrowbody space: 33.

Commuter space: 9.

Checks: B, C, D and modifications.

Large fans serviced: CF6.

Small fans serviced: JT8D.

Turboprops serviced: PW100.

The details for Euravia Engineering & Supply and European Aviation Maintenance on page 62 of the survey were transposed.

NEWS IN BRIEF

■ RAFAEL FLIES 'POPEYE PLUS'

Israeli missile developer Rafael is understood to have test flown a turbofan-powered version of its Popeye stand-off missile. The company is looking at several engine manufacturers, including Williams-Rolls and Turboméca, to provide the powerplant for an extended-range variant of the weapon.

■ SOLID RAMJET TEST

A French research and industry group has succeeded in flying what it claims is the first solid-fuelled ramjet to be tested in Europe. The "Rustique" missile (so called because it promises much lower purchase cost than current liquid-fuelled ramjets) was flown at the Centre d'Essais des Landes. The programme is led by French research institute Onera, and by Matra, with input from Aerospatiale, Celerg and SNPE. The effort is aimed at developing a short-to-medium-range ground-to-air missile, or a highly manoeuvrable air-to-ground missile. Maximum speed is about Mach 3.5.

IAI offers Phalcon technology to China

ISRAEL AIRCRAFT INDUSTRIES (IAI) is offering China airborne-early-warning (AEW) technology based on its Phalcon AEW aircraft to meet a Chinese air force requirement.

The Chinese have an outstanding AEW requirement, with several companies pursuing the business. GEC-Marconi Avionics is believed to have supplied its Argus system, based on its abortive AEW Nimrod programme, while Russia is offering the A-50 Mainstay.

The IAI Phalcon offer is in keeping with the defence ties between the two countries. China is using the defunct Israeli air force Lavi programme as the basis for its next-generation fighter. □



Westland hasn't given up on Canada

Westland woos Canada on EH101

JIM BAGNALL/OTTAWA

WESTLAND is again attempting to persuade Canada to purchase the EH Industries EH101 as the helicopter programme is believed to be about to receive a considerable fillip with a UK Ministry of Defence order for around 25 aircraft.

A procurement to meet the Royal Air Force's long-standing utility-helicopter requirement is expected to be announced on 2 March. The bulk of the order will be for the EH101, with up to an additional ten Boeing CH-47 Chinooks also being acquired.

Westland and Agusta, which form EH Industries, will push the EH101 to meet Canadian search and rescue (SAR) and anti-submarine warfare helicopter requirements. Funding for both

requirements was due to be determined on 27 February with the release of the Canadian Government budget.

The Canadian Defence Department has a requirement for 35 ASW helicopters, with a further 15 required for SAR. Westland and Agusta would offer the EH101, dubbed the Cormorant AW320, for both roles.

An initial contract for both requirements collapsed in late 1993. The then-recently elected Liberal Government threw out the EH101 on the grounds that it was too expensive.

The companies now say that they can supply 45-50 Cormorants at C\$202.5 billion (\$144 billion), roughly half the cost of the original programme.

Philip Burton, a Westland director and executive in charge of over-

seas sales, says: "The sunk costs, the non-recurring costs, have already been paid by the British and Italian Governments. Now Canada doesn't have to pay for them."

Westland and Agusta are now proposing what is essentially an off-the-shelf aircraft.

A Government decision has yet to be taken over whether it wants to own or lease its SAR fleet. In covering this option, Westland and Agusta are understood to be discussing the potential sale of the SAR helicopters to Canadian Helicopters, which would then lease the EH101s to the military.

The two companies are still engaged in negotiations with the Canadian Government over the cancellation cost of the first order. Burton says that the claim will not be dropped simply because the EH101 is being re-offered. □

UK may force Starstreak competition

IN AN ALMOST unprecedented move, the UK Ministry of Defence (MoD) may force missile manufacturer Shorts to compete for follow-on orders of its much-delayed Starstreak very-short-range air-defence system.

Belfast-based Shorts is now completing the first tranche of deliveries to the MoD, with the programme running almost five years late. Technical problems with the missile and its carriage

vehicle have led to the delays.

The MoD says that it has not ruled out any options, with a competition for production of two further batches of Starstreak a distinct possibility. Build-to-print has been a feature of US missile contests for many years.

Shorts admits that it is in discussions with the MoD over future production contracts. It would strongly object to the MoD holding a competition for the programme.

The last time the MoD attempted to put part of a programme to competition was on the Royal Air Force's Panavia Tornado GR.1/GR.4 mid-life upgrade. Although it awarded the initial contract to British Aerospace, it wanted to hold a competition for upgrading later batches of aircraft. The resulting wrangle between BAe and the MoD eventually led the Ministry to abandon plans for a competition. □

Multi-national bid scuppers CorpsSAM

RAMON LOPEZ/WASHINGTON DC

THE USA HAS finally dumped its CorpsSAM medium-range air-defence system in favour of an international programme to replace the Raytheon Patriot air-defence missile.

The USA, Germany, France and Italy have agreed in principle to jointly develop and produce a next-generation medium-range air-defence weapon.

The four NATO members signed a letter of intent to co-operate on the research and development of a mobile surface-to-air missile able to neutralise tactical ballistic missiles, stealthy cruise missiles and advanced bombers.

The move spells the end for the troubled CorpsSAM project in

which US firms were competing to provide the Pentagon with the Patriot replacement.

Details of weapons development will be laid out in an inter-governmental memorandum of understanding to be signed in October. The MoU will specify each country's financial commitment and programme management issues.

The total cost of the Medium Extended Air Defence System (MEADS) is unknown, but Pentagon officials say that research and development will cost at least \$2 billion. The deal calls for a programme cost and workshare of about 50% for the USA, 20% each for France and Germany and 10% for Italy.

John Deutch, the Pentagon's deputy defence chief, says: "This is an important capability for an uncertain world in which proliferation is taking place...I regard MEADS as a model of the kind of co-operation that is required in the post-Cold War world, where we still face dangerous threats, but our budgets are reduced."

The first research and development phase, project definition and validation (PD&V), will be conducted by two competing US/European industrial teams. One team will be selected to finish research and development and build the air-defence weapon.

The Pentagon will issue a request for proposals (RFP) for the MEADS later this month. US competitors will be selected in October, and international teaming is to be completed within a year.

The PD&V will run from 1996 to 1998, and the MEADS winner would be selected in early 1999. Initial fielding of the MEADS is scheduled for 2005.

The CorpsSAM competitors are expected to bid on the MEADS. They include Hughes Aircraft, Lockheed, Loral, Martin Marietta and Raytheon. European firms expected to bid include Aerospatiale, Alenia, DASA, Thomson-CSF and Siemens. □

Thais seek funding for fighters

THE THAI AIR force is pushing for funding in the next defence budget for an additional 18-20 fighter aircraft to equip its third frontline squadron.

The air force has been receiving informal preliminary briefings from competing manufacturers and is expected to make an official request for more information shortly.

Aircraft on offer are the Dassault Mirage 2000-5, Lockheed's F-16C/D, the McDonnell Douglas (MDC) F-18C/D and Mikoyan MiG-29.

The F-16C/D is considered by many to be the air force's most likely choice. Thailand already operates 18 early-built Block 15 F-16A/Bs and will begin taking delivery of a second squadron of 18 fighters in October.

MDC is also keen to secure another F-18 sale in Asia, having already sold eight aircraft to Malaysia and, more recently, lost a deal to Lockheed, with its F-16C/D, in Singapore.

The company is understood to have lowered its unit price to under \$25 million to compete



McDonnell Douglas is pushing F-18s to Thais

more effectively against the F-16.

Bangkok-based defence sources, however, are sceptical about whether the air force will receive approval for more fighters before the start of the 1996 financial year on 1 October. The budget is due to go before the Thai cabinet in April.

Observers suggest that the Government will want the air force to fully absorb its second F-16 squadron before funding a further purchase, with the 1997 budget considered politically more acceptable. □

NEWS IN BRIEF

■ HERON HIGH FLIER

The Heron long-endurance unmanned air vehicle (UAV) developed by Israel Aircraft Industries (IAI) reached an altitude of 32,000ft (9,750m) during a test flight on 20 February. The Heron is 8.5m long and has a wing span of 16.6m. The eventual maximum altitude of the UAV will be 35,000ft, with a maximum take-off weight of 1,100kg.

■ SECOND C-17 SQUADRON

The first McDonnell Douglas C-17 transport has been delivered to Charleston AFB, South Carolina, for the formation of the second operational C-17 squadron. The 14th Sqn of the 437th Airlift Wing is switching to the C-17 from the Lockheed C-141. It will be operated alongside C-17s of the 17th Airlift Sqn from the same Airlift Wing, which was declared operational for global operations on 17 January.

Russian An-124 offer fuels FLA fears

A RUSSIAN OFFER to supply Antonov An-124 heavy-lift aircraft as settlement for the country's debt to Germany is raising fears that the Federal finance ministry could use it to undermine procurement funding of the Future Large Aircraft (FLA).

According to the German defence ministry, the offer is to be examined by an inter-ministerial expert group under the supervision of the Federal finance ministry.

Russia is reportedly offering between four and eight of the heavy transports as payment of its German foreign-trade deficit.

Sources in Bonn fear, however, that the finance ministry could use the offer as an argument to hold

up funds for the purchase of the German air force's FLAs. These are intended to replace ageing Transall C-160s in 2010, despite the different roles of the two types.

There are further fears that the idea may have the backing of German chancellor Helmut Kohl, because he wants to establish closer industrial ties with Russia.

The Bonn defence ministry is expected to scorn the Russian offer, partly to protect the FLA, and partly because of reported user dissatisfaction with the An-124's four ZMKB Progress D-18T turbofans.

One defence ministry source says that Germany needs the Antonov "...just as urgently as we need a white elephant". □

USA opens the door to East Europeans

DOUGLAS BARRIE/LONDON
ANDRZEJ JEZIORSKI/MUNICH

IN A MARKED CHANGE of policy, the USA has cleared the way for Eastern European countries to buy US combat aircraft and other conventional weapons.

Poland has already started discussing the supply of second-hand Lockheed F-16A/Bs to replace part of its fleet of Russian fighter aircraft, having previously been blocked in its attempts to buy the aircraft.

The USA and Poland are understood to be in preliminary talks about the supply of up to 24 Lockheed F-16A/Bs held in stock at Davis Monthan AFB, Arizona. Up to 200 early model F-16s are now held at the base.

The policy change was made apparent following a recent meeting between William Perry, US defence secretary, and Jerzy Milewski, the acting Polish defence minister.

Under the auspices of Presidential Decision Directive 34, covering conventional-arms sales, Poland, along with Albania, Bulgaria, the Czech Republic, Estonia, Hungary, Latvia, Lithuania, Romania and Slovakia will now be able to purchase US military equipment.

One source says that Lockheed

has been concentrating on Poland, with the F-16 on top of the agenda. "Washington's policy toward any sale appears to have softened considerably," he says.

The US Department of Defense confirms that it is in discussions with Poland, but says: "A decision to sell is some time off."

Polish officials also confirm that the US offer has been made, but warn that funding for such a procurement is not readily available. They also say that an offer of only ageing A/B model F-16s may not be acceptable.

Poland, along with Hungary and the Czech Republic, has expressed an interest in acquiring surplus F-16A/Bs. Previously, the US Government had blocked the release of aircraft because of Russian antipathy toward such a deal.

The aircraft to be supplied would be likely to receive what is known as the "Falcon Up" structural-maintenance programme to extend the aircraft's service life. AIM-9 Sidewinder infra-red guided air-to-air missiles would also be supplied. The programme would be contractor supported.

A Polish sale would almost certainly spark renewed pressure from both Hungary and the Czech Republic for the release of the aircraft. □



The RAF is about to get its first TIALD Jaguars. Harriers will follow

BAe studies TIALD for Harriers

BITISH AEROSPACE is carrying out a project-definition study into equipping the Royal Air Force's BAe Harrier GR.7s with the GEC-Marconi Thermal Imaging and Laser Designation (TIALD) pod.

The TIALD pod is already in service with the RAF on its Panavia Tornado GR.1 strike aircraft. The air force has been looking to provide the Harrier with a self-designation capability for the delivery of stand-off laser guided bombs such as the Texas Instruments Paveway II and Paveway III.

The RAF is also fitting the TIALD pod to some of its Sepecat Jaguars. The first of the modified Jaguars was officially handed over to the RAF on 24 February by prime contractor, the UK Defence Research Agency.

To provide the single-seat Jaguar with a TIALD designation capability, a hands-on-throttle-and-stick control column, head-down display, wide-angle head-up display, global-positioning system and a 1553 digital databus were fitted.

The RAF decided to modify 12 Jaguars for the TIALD role in February 1994, and a decision in principle to carry out a similar programme for the GR.7 is believed to have been made at the same time. □



The Jaguar's cockpit has been considerably modified

NEWS IN BRIEF

■ P-3C UPGRADE

Litton has begun production of more than 200 modification kits to upgrade ALR-66A(V)3 electronic-warfare systems on US Navy Lockheed P-3C maritime-patrol aircraft following the successful completion of development testing. The ALR-66B(V)3, as the upgraded hybrid system is known, houses a modified direction-finding antenna fitted in a belly-mounted radome.

USN upgrades E-6A to command post

ONE-THIRD OF THE US Navy's Boeing E-6A TACAMO (take charge and move out) long-endurance communications relay fleet are likely to be modified and upgraded to incorporate the capabilities of the US Air Force's Strategic Command's Boeing EC-135 Airborne Command Post (ABNCP) aircraft.

The upgraded aircraft will be redesignated E-6B for their new multiple role which will supplement, and eventually take over from, the ageing EC-135 fleet.

The prime role of the older

ABNCP has been diminishing for years since the advent of the 747-based Boeing E-4A (later upgraded to B), Advanced ABNCPs in the mid-1970s.

The role of the ABNCP is to provide critical communications between the US National Command Authority and strategic forces during and after a nuclear or conventional attack on the USA.

The E-6As are much younger, CFM International CFM56-powered, airframes that originally replaced ageing Lockheed EC-130Q TACAMOs during the late

1980s and early 1990s.

The conversion work, to be undertaken by Texas-based Chrysler Technologies Airborne Systems (CTAS), will "cross-deck" EC-135 ABNCP equipment to the E-6A as part of the modification to E-6B configuration.

The first E-6B will be delivered by mid-1997. The initial \$95 million contract includes aerodynamic and structural analyses, systems engineering, electrical and mechanical design, kit manufacture and installation, airframe and avionics testing. □

Executive Jet sells all 1995 Ultra shares

EXECUTIVE JET Aviation (EJA) says that it has sold full shareholdings in 16 Citation Ultra business-jets due for delivery in 1995 for its NetJets fractional-ownership programme.

The aircraft are part of a \$150 million order for 25 Citation Ultras announced in July 1994. First delivery is due in June.

The Montvale, New Jersey-based company operates 25 Cessna S/IIIs and 13 Raytheon Hawker 1000s under the NetJets programme, and has seven

Gulfstream IV-SPs business-jets on order. EJA holds options on 13 more GIV-SPs and two long-range Gulfstream Vs.

Under the NetJet programme, EJA sells shareholdings in aircraft which it then operates on behalf of the owners. The firm also operates charter and fleet-management businesses.

EJA reports that its charter business has grown by 35% and that Executive Jet Management scored 25% growth in its fleet-management business. □

Cessna spells out plans for single-engine revival

CESSNA AIRCRAFT has revealed new details of its plan to re-enter the single-engine piston aircraft market. Cessna chairman Russ Meyer says that his firm will build 2,000 model 172s, 182s and 206s in 1998 — the first full year of production.

The initial 25-30 aircraft, to be used for flight demonstration, will be fabricated at Cessna's Wichita site. Construction of a new aircraft-manufacturing plant at Independence, Kansas, about 150 miles from Wichita, is to be completed in early 1996. The first aircraft will be rolled off the new production line in September 1996.

Cessna's strategy is to build up to 2,000 model 172/182/206s

annually. Meyer says that the split in 1998 will be between 900 and 1,100 172 Skyhawks, 400-600 182s and 400-500 206s.

The Skyhawk will be the first aircraft built at Independence, with the 182 following in 1997. Full-rate production of the Model 206 will begin in 1998. The new production will generate about \$300 million in yearly sales and create as many as 1,800 new jobs in Wichita and Independence.

Cessna will soon begin taking aircraft orders, but Meyer believes that his market projections for new single-engine piston aircraft are conservative. "We are building up to a rate we think is sustainable," he says.

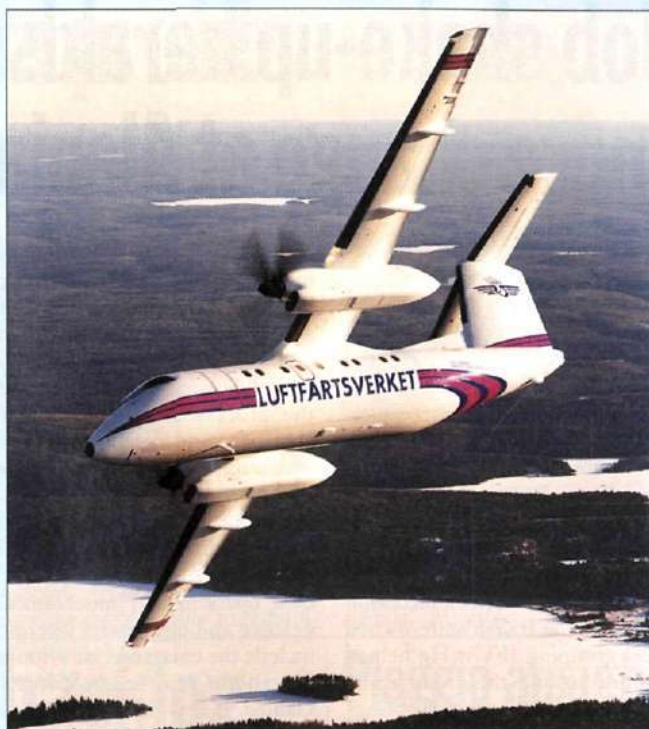
The aircraft will be significantly improved. Most enhancements have been selected, and will be unveiled in the next three months, as will the price lists. Cessna has signed vendors, including engine manufacturers, but their identities remain secret for now.

Meyer has previously said that the aircraft will incorporate new avionics, flight-control systems, engines and interiors, including new seats. They will continue to be aluminium aircraft. Heavy emphasis is being placed on safety and systems redundancy. □

NEWS IN BRIEF

■ SIA LEARJET ORDER

Singapore Airlines (SIA) has ordered two more Learjet 31s and four Learjet 45 aircraft, worth \$65 million, for pilot training. They replace four Learjet 31s in service since 1991. The two new 31s are due for delivery in December and the four 45s in 1997.



Norway takes Dash 8 for calibration duties

THE NORWEGIAN CIVIL AVIATION Administration has taken delivery of this Bombardier de Havilland Dash 8-100 for navigation calibration duties. The aircraft is fitted with a calibration suite developed by the NCAA, together with Normarc of Oslo.

Samsung considers joining four-seat Skycar project

SOUTH KOREA'S Samsung Aerospace has agreed to study the feasibility of jointly developing a four-seat vertical take-off and landing (VTOL) aircraft with US designer, Moller International.

Davis, California-based Moller, has been developing the ducted-fan Skycar since 1983 and has invested \$35 million in the programme to date.

The Skycar has four ducted fans at the "corners" of the aircraft. Each duct houses a pair of contra-rotating fans, each individual fan driven by a rotary engine. The fixed forward-facing ducts act as annular aerofoils in forward flight, while vanes vector the fan thrust for vertical lift and flight control.

A precursor of the Skycar, a single-seat saucer-shaped aircraft

with eight lift fans, has been flown some 200 times, Moller says. A prototype Skycar has been completed, and is awaiting development of the powerful, lightweight rotary engines required to make the concept viable. The high installed power results in an estimated cruise speed of 355kt (660km/h).

Moller says that it is close to completing a prototype twin-rotor engine weighing 30kg and producing 120kW (160hp). Samsung's initial interest is in the engine, which should be in production by the end of 1995, Moller says.

The Korean company is conducting a two-month study of the engine and Skycar before deciding whether to invest in their development. □

Job shake-up heralds more change at Alenia

KEVIN O'TOOLE/LONDON

A FURTHER ROUND of restructuring is expected at Alenia following a shake-up of the top jobs at the Italian aerospace group by its parent Finmeccanica.

Giorgi Zappa has been appointed to head Alenia, while joint presidents Fausto Cereti and Enrico Gimelli will move to new jobs elsewhere within the group.

Zappa joined Alenia as general director in 1993, after a successful career at the Italian state-owned steel grouping IFVA. He helped to turn around the group ready for partial privatisation. He brings with him a reputation for tight industrial management.

IFVA was the steel arm of IRI, the giant state-owned holding company which controls a large

chunk of Italian industry, including Finmeccanica and national airline Alitalia. Further privatisations are expected as the debt-laden holding company restructures.

Finmeccanica itself has been in the process of reorganising its aerospace and defence interests, which were expanded in 1993 by the addition of five companies, including Agusta, from the failed state holding-company, EFIM.

Besides Agusta and Alenia's own operations, Finmeccanica's defence and electronics interests include the enlarged Fiar avionics operation, Otto Melara, SMA and Galileo. It also holds a 35% stake in Aermacchi and an interest in bankrupt Piaggio.

In his new job, Gimelli will join the Finmeccanica management team to oversee group strategy in handling these defence operations. In a brief statement, Finmeccanica says that the need for a "more clearly defined management structure" for its defence businesses lies behind the boardroom shake-up.

Cereti has been moved within Alenia to handle the company's strategy on partnerships and joint ventures. These include the merger between ATR and British Aerospace Regional Aircraft, as well as the alliance discussions with McDonnell Douglas. Further partnerships and, possibly, disposals are expected as Finmeccanica slims down its aerospace and defence operations to a profitable core. □



Boeing 767s increase capacity and help Air Canada back to profit

Expansionist Air Canada swings back to profitability

AIR CANADA HAS posted its first profit in five years, and chairman Hollis Harris plans to keep the momentum rolling in 1995 with a further double-digit capacity expansion.

Group net profits of C\$129 million (\$92 million) in 1994 mark a dramatic turnaround from the C\$326 million loss made the year before. Operating profits were maintained, even during the fourth quarter, to allow the company to end the year on a record high.

Behind the improvement is a 12% expansion in seat capacity, combined with a 6% decline in unit costs. While capacity rose to record levels, staffing numbers have shrunk by 20% since the boom of the late 1980s, says Harris.

He outlines plans to add another 13% to capacity in 1995, through a combination of increased use and the addition of 19 aircraft to the fleet.

The expansion in 1994 was achieved by re-calling three Lockheed L-1011s from desert storage and taking delivery of one

new Boeing 767-300ER. The capacity increase has resulted in a large-scale rehiring of pilots by the carrier, which says that by October all 243 pilots laid off two years ago will have been rehired.

The expansion has taken its toll on load factors, which slipped two points to 63%, but that was largely offset by a 3% growth in yields.

"We are ready to give up a point or two on load factors and achieve higher yields. A [low] load factor also means that in a growing economy, our route system has enormous potential to generate incremental revenues without adding cost," says Harris.

He cautions that Air Canada needs to continue to improve profitability to fund its \$1 billion fleet-renewal programme, while continuing to fight tough competition, especially in the wake of Canada's "open-skies" agreement with the USA, signed on 24 February. Harris adds that Air Canada can compete with the US majors on unit cost and fleet utilisation. □



Cereti: negotiating Alenia's future

MoD budget windfall may offset savings shortfall

THE UK MINISTRY of Defence (MoD) has received an unexpected £600 million cash windfall in this year's military budget, and may use it to offset savings shortfalls in the Defence Cost Studies (DCS).

UK Treasury figures released last week reveal an underspending in the 1994-5 defence budget, with the figures falling £600 million short of the original estimate of £22.8 billion.

The underspending is being attributed to savings in operational costs and to less-than-projected expenditure on major project (Category A) equipment costs.

With the MoD struggling to achieve the annual £750 million savings required by the DCS, the underspending could be used to plug financial gaps over the next financial year.

The savings are partially

explained by the MoD being able to defer payment on equipment contracts where industrial suppliers have failed to meet project milestones. There is evidence to suggest that with an upturn in the UK economy and other business opportunities appearing, suppliers have been more willing to miss MoD milestones.

A change in Government policy also means that the MoD has been

allowed for the first time to carry forward all of the savings made on operational budgets. In the past, operational funding was lost if it remained unspent at the end of the budget year, which gave little incentive to make savings.

When the carry-forward policy was introduced in other government departments, a first-year saving of around 3% was recorded, which tallies with the MoD's experience. □

Air New Zealand boosts profits

AIR NEW ZEALAND (ANZ) boosted profits in its first half-year, despite continuing problems with its domestic Boeing 737 fleet and a rapid expansion of capacity on international routes.

The New Zealand carrier managed to raise net profits by nearly 60%, to more than NZ\$140 million (\$89 million) in the six months to the end of December. Chief executive Jim McCrea says that the airline is comfortably on course to beat 1994's result of NZ\$191 million for the full year to June.

McCrea points to a strong performance on international routes, where ANZ managed to post a real improvement in yields, despite the

strength of the New Zealand dollar and heavy capacity expansion.

Overseas ticket sales were up by around one-quarter in most Asian and American regions, with Europe only marginally behind, at 16%. The growth would have been higher, but for the strong currency, says McCrea. The result came from a healthy international traffic growth of 22%, he adds.

Capacity grew at an even faster 25%, as new aircraft joined the fleet towards the end of the year. Two Boeing 767-300s were brought in to replace older and smaller leased 767-200s and the carrier took out a medium-term lease on a Boeing 747-400 for use

on long-haul Pacific routes. A 747-200 has also been leased for five months.

Domestic performance also improved, but ANZ says that the domestic 737 operations "...continue to provide inadequate returns on the significant investment involved". The carrier has since grounded ten of its 13 hushkitted 737-200s after turbine-blade failures.

McCrea also admits that the carrier's regional development is "overshadowed" by Australia's decision in October to freeze its open-skies agreement with New Zealand. "The New Zealand Government continues to remind



McCrea: strong internationally

Australia that the matter is neither forgotten nor off the bilateral agenda," he warns.

Jetstream aims for J41 backlog

KEVIN O'TOOLE/LONDON

JETSTREAM AIRCRAFT aims to build a three-year backlog for its J41 30-seat turboprop to take into the alliance with ATR when the merger is completed by the end of this year.

Marketing director Nick Godwin estimates that orders for the J41 earned it a 59% share of the 30-seat airliner market in 1994, with firm orders for 67 aircraft and another 35 commitments.

With deliveries scheduled to run at 30 aircraft a year, Jetstream would have to come close to repeating this performance to reach the backlog target by the end of the year.

The joint venture, which brings British Aerospace's Jetstream and Avro regional-jet units together with ATR, should be signed by the end of April, but will still have to

pass European competition rules. The companies will then begin to merge marketing and customer-support functions at Toulouse.

The J41 is effectively the only production aircraft which Jetstream takes into the joint venture. The 19-seat J31 Super will still be produced on demand, but none are now on order. "We believe that the J41 will become the entry-level aircraft," says Godwin.

Airline economics dictate that the 19-seat market will be dominated by used aircraft and that without fresh sales the new-build market is "threatened by extinction", says Godwin. Jetstream's sister leasing company JSX is managing a portfolio of nearly 300 J31s, for which BAe holds the financing liabilities.

Over the next decade, Jetstream forecasts that world 19-seat aircraft sales will run at around 30 a year.

By contrast, the 30-seat sector is expected to produce annual deliveries of more than 100 aircraft.

Jetstream is also due to abandon planned production of the J61, a revamped version of the 70-seater ATP. Godwin says that Jetstream will nevertheless press ahead with the J61 certification and produce between four and six of the aircraft, which are "significantly built". These are likely to be sold to a single operator.

Godwin admits that the labour-intensive 70-seater was clearly uneconomic, given depressed market prices. "The decision was going to be made irrespective of the joint venture, but we had to keep up pressure on the partners," he says. BAe plays down speculation that the line could eventually be transferred to India, which has previously built the ATP predecessor, the BAe 748.

Piaggio anxiety increases

CONCERN OVER the future of Piaggio is growing as attempts to find a new owner fail to progress. The troubled Italian aerospace company has been run for the past three months by administrators appointed by the Italian bankruptcy courts.

Switzerland's Pilatus group has withdrawn from the bidding, leaving the possibility of a renewed joint bid from Finmeccanica/Aermacchi and an undisclosed offer from Finprogetti, an Italian holding company apparently acting for foreign buyers.

The Finprogetti proposal is now to "rent" the company for three years, before going through with the purchase, but this is understood to have met a cool reception from the administrators.

Lockheed executives retire before merger

KENNETH CANNESTRA, who heads Lockheed's aeronautics unit, has become the latest senior executive to announce early retirement ahead of the US aerospace group's merger with Martin Marietta.

Cannestra was to have been in charge of the combined aeronautics division until the end of this year,

when he would have reached the mandatory retirement age of 65. The job will instead go to James ("Micky") Blackwell, who headed the F-22 advanced tactical fighter project.

Lockheed says that Cannestra's decision was taken to ensure continuity of leadership.

Gordon England, president of

Lockheed's Fort Worth division, recently surprised colleagues with the announcement that he will retire in May at the age of 57.

Lockheed and Martin Marietta have admitted that the number of senior retirements due among their respective managements has helped to ease the process of combining the groups.

NEWS IN BRIEF

■ **AIR WISCONSIN IN PROFIT**
US regional carrier Air Wisconsin turned in operating profits of \$2.9 million a year after its buy-out from the United Airlines group. The United Express carrier was bought out by a group of three airline executives at the end of 1993. It posted \$2.5 million before tax for 1994.

Endeavour prepared for longest Shuttle flight

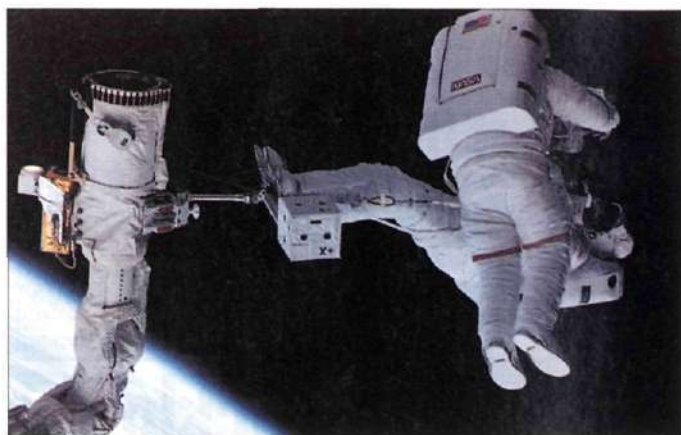
TIM FURNISS/LONDON

THE SPACE SHUTTLE *Endeavour*/STS67 is scheduled to lift off from the Kennedy Space Center, Florida, at 01.27 local time on 2 March to attempt a 16-day mission, the longest by the Space Shuttle.

Carrying the Astro 2 payload of three ultraviolet astronomy telescopes, the *Endeavour* will be operated on a 24h basis, with a split crew of seven, including two professional astronomers, Ron Parise and Sam Durrance. They will work in two shifts to operate the telescopes, which are mounted on a computer-controlled Instrument Pointing System, from the aft flightdeck.

The Hopkins Ultraviolet Telescope will be used to study faint astronomical objects, such as quasars and supernova remnants, as well as the outer planets of the solar system. The Ultraviolet Imaging Telescope will acquire images in the broad ultraviolet waveband, while the Wisconsin Ultraviolet Photo-Polarimeter Experiment will study celestial objects such as hot stars, galactic nuclei and quasars.

Each telescope, which will be co-aligned to view simultaneously the same astronomical object, was flown aboard the first Astro mis-



STS63 astronauts at work in the course of their spacewalks

sion, the STS35/*Columbia* in December 1990, the crew of which included Parise and Durrance. Although this mission generated considerable data, it was thwarted largely by several technical problems. Further planned Astro missions have been cancelled because of budget cuts.

The *Endeavour*'s payload bay is also equipped with an Extended Duration Orbiter kit with additional cryogenic fuel cells to complement the electrical-generation system. This allows missions to last longer than 10-11 days, the maximum duration of the standard orbiter configuration.

■ The STS67 will take off 19 days after the landing of the *Discovery*

after its STS63 mission. This included a spacewalk which posed more questions than it answered about the Alpha space station astronauts' ability to construct and maintain it regularly.

About 450h of spacewalking will be required to construct the station over three years, plus about 170h a year for maintenance.

The USA has accumulated only 295h of spacewalk time in 60 missions, dating back to the Gemini 4 in 1965 and including moonwalks. Twenty-four Space Shuttle walks, since the first in 1983, have accumulated 165h. Russia — which will also assist in space station assembly and maintenance — has 235h experience from 58 spacewalks. □

Mir enters tenth year in orbit

THE CORE MODULE of the Russian Mir 1 space station entered its tenth year in orbit on 20 February, three days after the routine docking of a tanker ship, the Progress M26.

The Mir, which now consists of a Kvant 1 astrophysics module, and the Kvant 2 and Kristall modules, is being operated by its 17th "main mission crew", Alexander Viktorenko, Yelena Kondakova and Valeri Poliakov. They will be joined on 16 March by the 18th crew, Vladimir Dezhurov, Gennadi Strekalov and the first US astronaut to ride on a Russian rocket, Norman Thagard.

The Progress M26 carried 100kg of US equipment, to be operated by Thagard during his 90 day-plus flight, before he returns aboard the Shuttle STS71/*Atlantis*, which is to be launched on 8 June with the 19th Mir mission crew. □

NEWS IN BRIEF

■ FRUIT FLIES FLY

Russia's Foton 10 recoverable microgravity research capsule was launched on a Soyuz booster from Plesetsk on 16 February. The Foton carries the fourth European Space Agency experiment to fly on such a craft. Called the Biobox 2, it is an incubator with experiments on cells to study bone mineralisation in weightlessness, and fruit flies and algae for the study of small living organisms. The Foton 10 is due to land on 3 March.

■ CELLULAR GO AHEAD

The US Federal Communications Commission has granted licences to Motorola, TRW and Loral/Qualcomm to operate the worldwide hand-held cellular-telephone satellite systems Iridium, Odyssey and Globalstar, but not to Constellation Communications and Mobile Communications. Inmarsat plans a competitive system, called Inmarsat P.

Four to bid for Nilesat

FOUR INTERNATIONAL consortia have been invited to bid for a contract from Egypt to build a turnkey satellite system, called the Nilesat.

The consortia are led by Aerospatiale, whose team includes Daimler-Benz Aerospace, Alcatel, Alenia and Space Systems/Loral; Hughes Space and Communications; Martin Marietta Astro Space; and Marra Marconi Space.

Two direct TV broadcast satellites, including one ground spare, will be built, plus two ground-control stations. □

Date set for critical Ariane launch

ARIANESPACE HAS set 14 March as the date of the launch of an Ariane 44LP on flight V71, from Kourou, French Guiana, carrying Eutelsat's first direct TV broadcast satellite, the Hot Bird 1, and the Brasilsat B2 satellite into geostationary transfer orbit.

The company has invested \$8 million in modifications to the Ariane 4 third stage after a malfunction caused the loss of V70 and its payload, the PanAmSat 3, on 1 December 1994 (*Flight*

International, 4-10 January).

This was the second failure of an Ariane 4 in 1994 and, although Arianespace has a comfortable lead in the commercial-launcher market, with an orderbook of 39 satellites to late 1996, another failure could jeopardise its business position for launches after 1997.

Charles Bigot, the president of Arianespace, believes his company can make up the delay in planned launches in 1995 and meet a schedule of 30 launches to 1 January, 1997. □

Airlines put Nordam's window to the test

NORDAM HAS introduced a new airliner cabin-window designed to counter crazing — the thousands of scratches on airliner windows — which has reached epidemic proportions, according to airlines. The Tulsa, Oklahoma-based company's new Nordex EL cabin windows are being flight tested by 15 airlines.

"Nordex EL has been proven to outperform standard acrylics approximately five-to-one in laboratory tests," says Nordam Transparency division general-manager Bob Hart. More than 4,000h have been accumulated on some flight-test aircraft, with flawless results, it claims.

Other suppliers' windows have obscured vision in as little as 250h, Nordam maintains.

Crazing is a normal ageing

process that has become an increasing problem since early 1992.

Traditionally, acrylic cabin windows display linear cracking patterns, concentrated in the centre of the viewing area. The new pattern is evenly distributed and has a sparkling appearance, consisting of thousands of tiny "stars" which increase in number and severity as flights are accumulated.

While the exact cause of the damage is uncertain, the 1991 eruption of Mount Pinatubo and subsequent volcanic activity is believed to be partially responsible. It is possible that sulphur compounds are circulating in the atmosphere and creating the new craze pattern.

Aircraft manufacturers and major airlines are conducting in-service evaluation of several new windows. Some test windows feature coatings, but recent flight test results indicate that coatings have not yielded a satisfactory service life, Nordam says.

The transparency division duplicated the star-crazing pattern through laboratory simulation of pressure and temperature cycles and other flight conditions. "Duplicating results in a controlled environment is very beneficial in developing an improved cabin window," explains Hart.

Marketing manager Bob Brooks says Nordex EL is not a new material but is produced using improved processes. "While we are investigating several coatings in an effort to find the optimum solution, Nordex EL is currently available to operators worldwide," he says.

Cabin window cracking and crazing can be removed through hand-held sanding, machine slurry-polishing or diamond milling. "Nordam Transparency offers operators diamond-milling cabin-window repair for premium edge-to-edge optics, the smoothest surface finish, and a maximised service life," Brooks says.

"The secret to accomplishing the best repair is to avoid polishing or buffing after the diamond milling," he explains. □



VEGA delivers Harrier cockpit trainer

A TRAINING SYSTEM enabling Royal Navy maintenance technicians to become familiar with the cockpit layout of the British Aerospace Sea Harrier F/A2 has been delivered to the Royal Navy Air School at Yeovilton by VEGA, the UK-based software and systems engineering group. The cockpit orientation trainer, built by subcontractor Ogle Design, is part of a wider £3.5 million scheme covering the provision of 27 computer workstations providing students with a "virtual" Sea Harrier capable of being used to teach fault diagnosis. The system is due to be accepted by the Navy in April.



ARINC and Magellan sign with Globalink customer

ARINC AND MAGELLAN Systems have signed a memorandum of agreement with a launch customer, an unnamed regional airline, for the Globalink/CNS integrated satellite-navigation and datalink-communication systems.

The agreement includes \$2.4 million-worth of Magellan CNS-10 avionics units, which sell for under \$10,000 each.

San Dimas, California-based Magellan plans to certificate the CNS-10 in the fourth quarter of 1995. The console-mounted unit includes a ten-channel global-positioning-system (GPS) receiver and a two-way

VHF datalink for the ARINC Aircraft Communications Addressing and Reporting System (ACARS).

The unit will have a flight-management capability to allow retrofit in aircraft lacking such systems. There will be space for a dedicated VHF datalink for use with local-area differential-GPS landing systems.

Magellan says that Special Category I GPS-approach certification of the CNS-10 is due in 1996. The basic receiver is compatible with the US Federal Aviation Administration's planned wide-area augmentation system, designed to improve GPS accuracy. □

NEWS IN BRIEF

■ AUSTRALIAN RADAR

Australian defence company MRad has won a \$18 million (\$24 million) contract to provide the Royal Australian Air Force (RAAF) with a Hornet Radar Evaluation Facility for its McDonnell Douglas F-18 fleet. The RAAF will use the system for technical evaluation of its AN/APG-65 radar's performance under simulated operational flight scenarios as well as evaluating operational flight-test programmes which may affect RAAF F-18 operations.

■ **PRESTON FOR CONTINENTAL** Software developer The Preston Group of Australia has added Continental Airlines to the list of users for its advanced airspace simulation software, Total Airspace & Airport Modeller (TAAM). Continental will use TAAM to solve airspace and airport congestion problems and to analyse proposed schedules.

Power struggles

For Snecma's new chief Bernard Dufour, the state can be both a friend and a foe

JULIAN MOXON/PARIS

Bernard Dufour is clearly a man who intends to make his mark on the French and European aero-engine industry. Since taking over as chairman and chief executive of Snecma in October 1994, his stand against French Government efforts to cut the price of M88 engines for the Dassault Rafale fighter and his views on the powerplant for the European Future Large Aircraft (FLA) military transport quickly established him on the international scene.

Although previously chairman of power-generation equipment builder GEC Alsthom, Dufour is an aviation thoroughbred. As a manager and director, first with Sud-Aviation and, later, Aerospatiale, he has been involved, primarily on production, in many of France's most important aerospace projects such as the Concorde, the Caravelle, the Puma helicopter, and the Airbus Industrie consortium. He became Aerospatiale's executive vice-president in the late 1970s.

His pride in French achievements in aviation is clear. The French aerospace industry has come from "non-existence" in 1945 to leadership of numerous European collaborative programmes. "It is a remarkable record," he says.

With this in mind, Dufour clearly wants to see Snecma make its mark in the development of a new civil engine, and the proposed 190kN (43,000lb) thrust CFMXX turbofan is the vehicle. "After working 25 years with the same CFM core, the time has



Bernard Dufour

"I feel the engine industry is a strategic one, so I hope our problems will be sorted out in the same way."

come to start a new size of engine, which is needed for the Airbus A340 as it grows to 300/310t."

Such an engine will need more than one application, however, and Dufour's recent highly public remarks insisting that the engine of the FLA military transport be a turbofan, and not a turboprop as presently planned, caused considerable consternation. While his desire was clearly to ensure the long-term future of Snecma's civil-engine business, the outburst angered Snecma's government owner, the French defence ministry, and others in the FLA community who felt that a turboprop was the best solution.

He still holds out hope for a turbofan, saying that the FLA is "not yet launched". He also points out that the UK, which has indicated that it might return to the programme, has specified a refuelling mission for the transport. "This favours a turbofan," he says.

The future of the relationship with General Electric, Snecma's equal partner in the CFM56 range, is clear. "We always said that the CFM agreement was the basis for the future of our civil-

engine business." Snecma has its own core demonstrator, the PAT (*Plan d'Actions Technologiques*), but Dufour denies that this means the CFMXX will have a Snecma core, effectively reversing the position held by GE in the CFM partnership. "I certainly want part of the core, but I don't expect all of it." The demonstrator has "many new features", however, which will be "...taken into consideration in the CFMXX", he says.

Dufour says that he is "promoting" the idea of R-R, Fiat and MTU joining in the CFMXX. "Nothing should prevent us opening the door to them," he asserts. He adds that GE "understands" that any European military programme "...would require a European content of around 75%".

Dufour met R-R chairman Sir Ralph Robins in November 1994, only a few weeks after he took over at Snecma after the untimely death of Gerard Renon. "We covered mainly the subject of the FLA. He indicated that he had no problem on collaboration," he says.

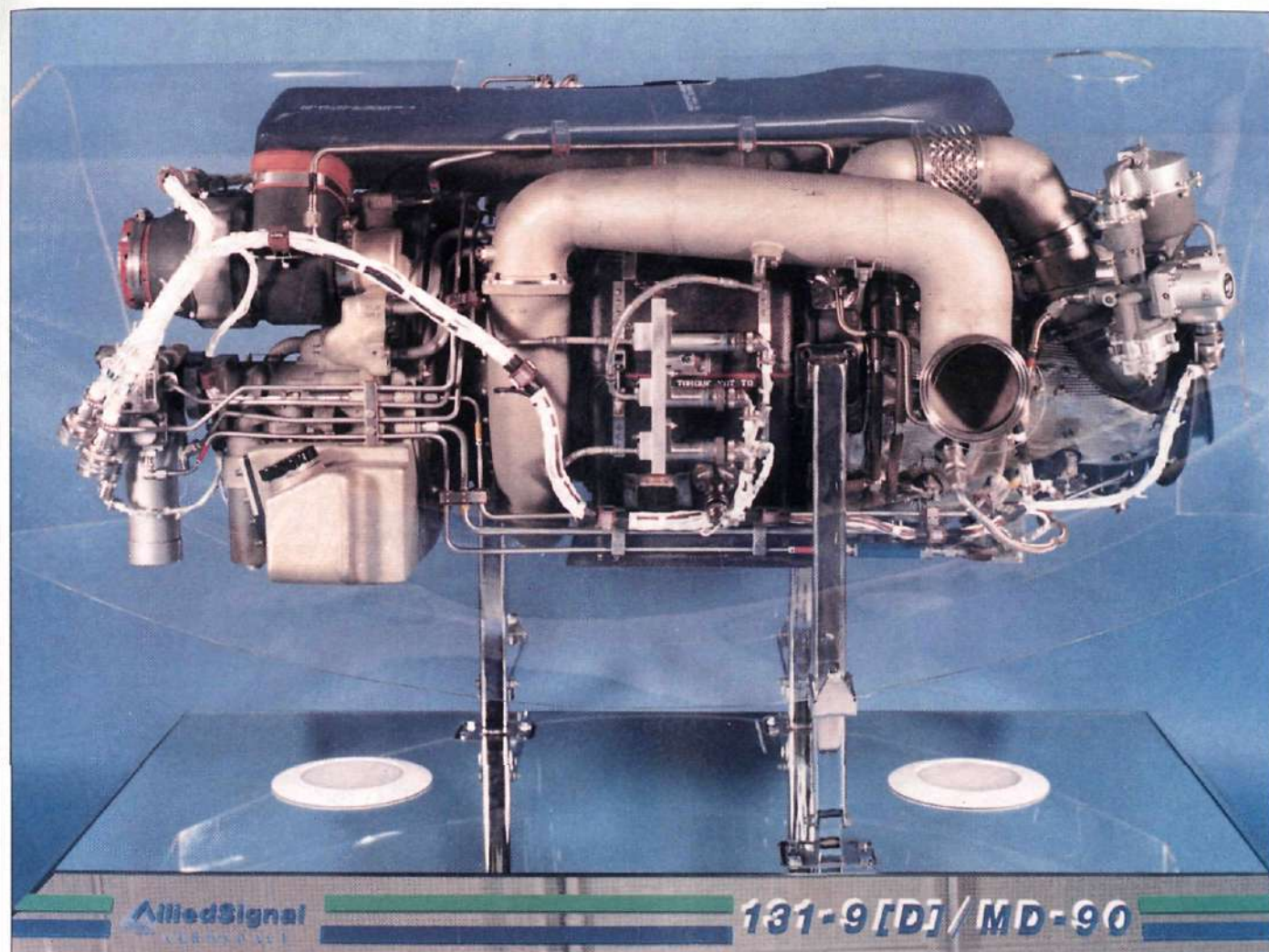
Dufour, who declares himself

an Anglophile, is better placed to talk about co-operation with UK companies than most French business leaders: the merging of GEC's and Alcatel's power-generation activities into the jointly owned GEC Alsthom being the most successful example to date of Anglo/French rationalisation.

That does not, however, stop him being critical of the UK aerospace industry for failing to live up to the promise of European collaborative programmes. "The UK has always been tempted to go it alone," he says, "but not all of their projects were successful. I have great admiration for the UK, and I believe it will be a good thing for them to become more committed to Europe."

Snecma will post losses of around Fr1 billion for 1994 and "...1995 is likely to be no better", says Dufour. He says that the difficulties have arisen for several reasons. "In 1989, there were big civil orders, which boosted us into a major investment programme. Then the market turned and we were a bit caught with regard to our workforce, and the oversized investments." Funding for development of the M88 fighter engine, the low value of the dollar, "...and the fact that we have received no money from the French Government for new programmes for two years", have also contributed to the losses.

The new president is uncompromising about the need for Fr2 billion (\$380 million) of state French Government money to recapitalise Snecma. "It is to help with our restructuring, and to prepare for the future." The money is needed to put Snecma on a similarly healthy financial footing to R-R, which Dufour says has achieved a "remarkable" comeback, "...thanks to the very heavy recapitalisation it received from the British Government". The example of R-R should be followed by the French Government, he says. "I feel the engine industry is a strategic one, so I hope our problems will be sorted out in the same way." □



Reliable power

The auxiliary power unit for the McDonnell Douglas MD-90 presented AlliedSignal with particular challenges.

GUY NORRIS/PHOENIX

When Delta Air Lines introduces its newest aircraft, the McDonnell Douglas (MDC) MD-90, into service in April, it will do so with high despatch-reliability targets — 98.6% in the first six months, and 99% thereafter. One of the most crucial elements in achieving such high levels from the first day will be the performance of AlliedSignal's latest auxiliary power unit (APU), the 131-9(D).

The MD-90, and particularly its International Aero Engines V2500 turbofans,

posed special challenges to the APU maker. "It started with the V2500 engine being harder to start," says AlliedSignal director of engineering, commercial APUs, Jim Rhoden. The MD-90 also had a higher electrical-power requirement than the current APUs could satisfy, says Rhoden. "Also, our competitor [Auxiliary Power International — APIC] had launched an engine and was competing, so we wanted to come up with something that was bigger and better."

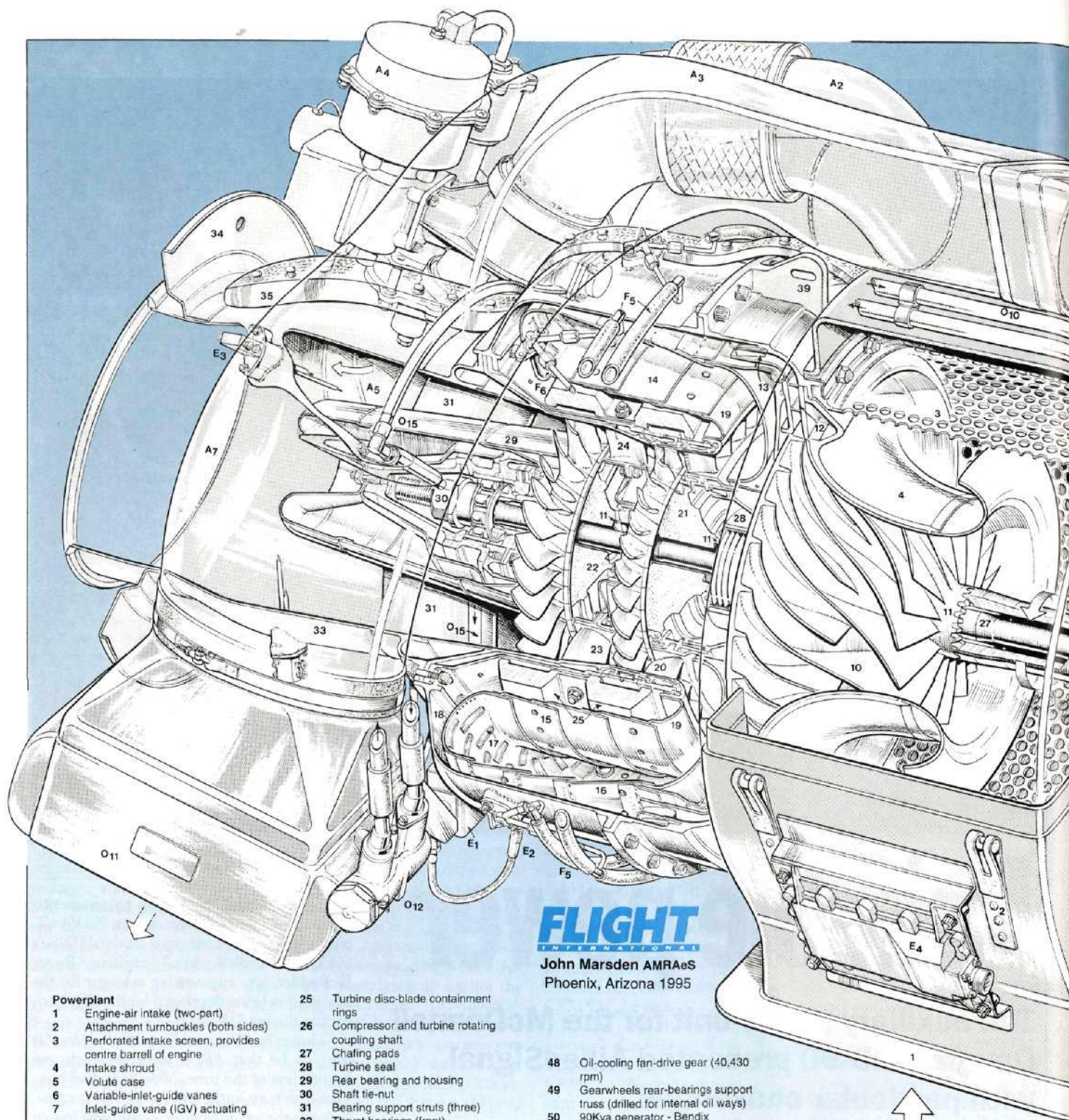
"There were a lot of questions asked about the 85-98(DHF) and 36-280(D), which are the APUs for the MD-80, but we just couldn't get

Tightly packaged to fit the existing space

there with the V2500 starting requirements. They also wanted to drive a larger, 90kVA oil-cooled generator, compared to the MD-80's 60kVA air-cooled unit," explains Roger DeRudder, now engineering manager for the new version being developed for the next-generation Boeing 737.

"Things had changed," says DeRudder. "It used to be that APUs were low-tech and burned less of the time. Now, even fuel consumption is an important factor." In the past, he says, the manufacturer could develop an APU to meet a set of requirements, but the performance would deteriorate over a period of time. Now, however, the OEMs [original equipment manufacturers] are asking for a 10% margin for deterioration. "This means we had to build in an extra 10% to get the same performance," says DeRudder. "The requirement also called for 10,000h between major overhauls and for component life."

In recognition of these tough requirements, and the "buyer's market" facing the aircraft manufacturer, AlliedSignal realised that nothing less than a new APU would be needed to stave off aggressive competition from APIC.



FLIGHT
INTERNATIONAL

John Marsden AMRAeS
Phoenix, Arizona 1995

Powerplant

- 1 Engine-air intake (two-part)
- 2 Attachment turnbuckles (both sides)
- 3 Perforated intake screen, provides centre barrel of engine
- 4 Intake shroud
- 5 Volute case
- 6 Variable-inlet-guide vanes
- 7 Inlet-guide vane (IGV) actuating gear
- 8 IGV actuator and push-pull rod (fuel activated)
- 9 Single-stage centrifugal load compressor impeller
- 10 Power compressor impeller
- 11 Curvic couplings - total eight
- 12 Diffuser case and guide vanes
- 13 Gas-generator exit guide vanes (Deswirl)
- 14 Annular combustor (reverse flow)
- 15 Inner liner
- 16 Outer liner
- 17 Dome louvres
- 18 Combustor case
- 19 Exit duct
- 20 Stator guide blades (first stage)
- 21 First-stage turbine rotor
- 22 Second-stage turbine rotor
- 23 Stator blades (second stage)
- 24 Turbine support case

- 25 Turbine disc-blade containment rings
- 26 Compressor and turbine rotating coupling shaft
- 27 Chafing pads
- 28 Turbine seal
- 29 Rear bearing and housing
- 30 Shaft tie-nut
- 31 Bearing support struts (three)
- 32 Thrust bearings (front)
- 33 Exhaust duct
- 34 Aircraft exhaust attachment ring
- 35 Segmented insulation blanket
- 36 Compressor case to gear wheelcase attachment flange
- 37 Integral gear wheelcase and oil-tank
- 38 Engine mounting trunnion fitting pads (one left-side, two right-side)
- 39 Lifting-hoist attachment lugs
- 40 Engine-power input drive (48,800 rpm)
- 41 Engine-speed-sensor transducer
- 42 Generator idler gear (27,215 rpm)
- 43 Generator drive gear (12,000 rpm)
- 44 Compound idler gear (13,740 rpm)
- 45 Wheelcase centrifugal breather impeller
- 46 Lubrication pump and fuel pump combined gear (8,020 rpm)
- 47 Starter gear & clutch (30,100 rpm)

- 48 Oil-cooling fan-drive gear (40,430 rpm)
- 49 Gearwheels rear-bearings support truss (drilled for internal oil ways)
- 50 90Kva generator - Bendix (internally oil cooled)
- 51 Aircraft electrical connections terminal block
- 52 Generator lifting lug-attachment boss
- 53 Electrical starter 28V
- 54 Starter electrical-terminal connections
- 55 Engine hand-turning screw-head slot for inspection (behind cover)
- 56 Oil-cooling-fan blower
- 57 All accessories attached by "V" clamps (except generator)

Air system

- A1 Delivery air-duct from volute case to aircraft environmental control system (ECS)
- A2 Surge-air duct to diverter valve

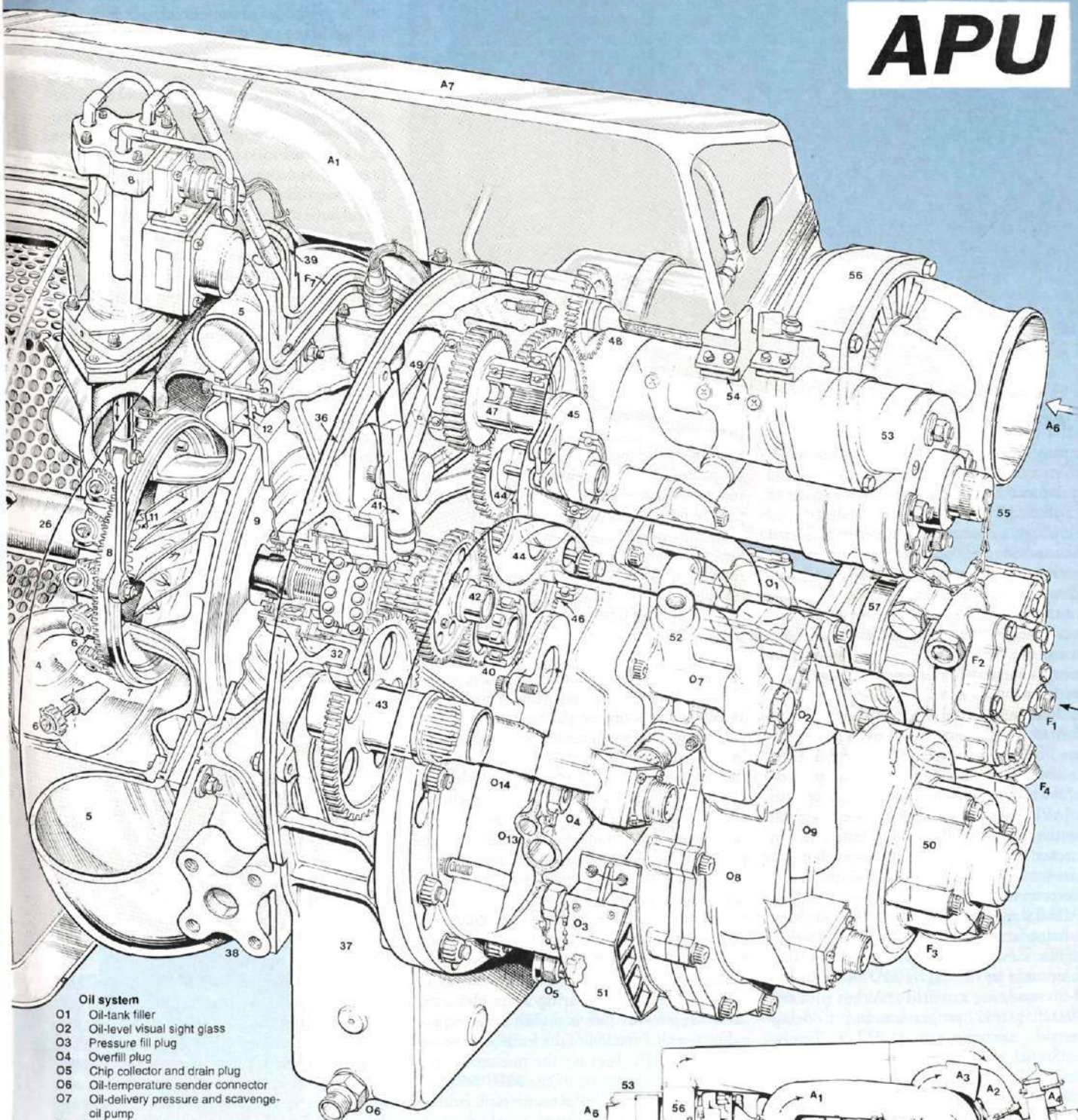
- A3 Expansion bellows
- A4 Diverter-valve (anti-surge control) air activated
- A5 Surge duct air exhaust
- A6 Air intake to oil-cooling fan
- A7 Delivery air-duct to oil-cooler heat exchanger

Electrical system

- E1 Ignition exciter box
- E2 Igniter plug
- E3 Engine exhaust gas-temperature thermocouples (total 2)
- E4 Engine-data memory module - full-authority digital engine-control
- E5 Transducer assembly

ALLIEDSIGNAL 131-9(D)

APU

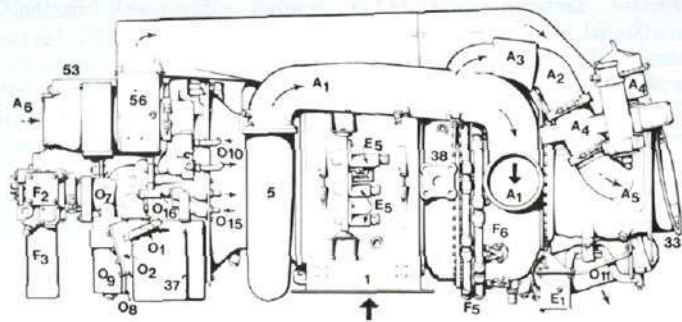


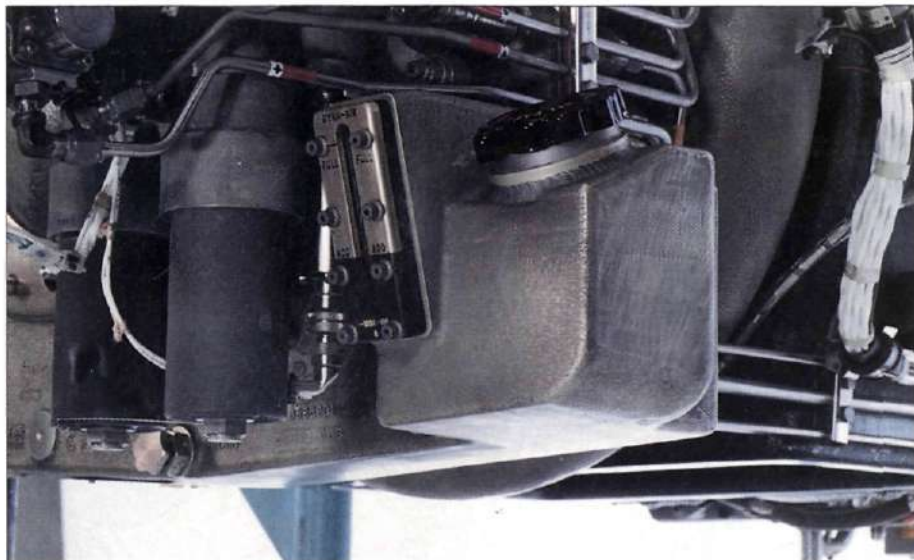
Oil system

- O1 Oil-tank filler
- O2 Oil-level visual sight glass
- O3 Pressure fill plug
- O4 Overfill plug
- O5 Chip collector and drain plug
- O6 Oil-temperature sender connector
- O7 Oil-delivery pressure and scavenge-oil pump
- O8 Oil-pressure filter
- O9 Scavenge-oil filter
- O10 Delivery and return pipes from oil-cooler heat exchanger
- O11 Air-cooled heat exchanger
- O12 Oil-flow divider
- O13 Generator cooling-oil gallery (scavenge oil)
- O14 Scavenge-discharge-oil transfer tube assembly
- O15 Delivery and scavenge return from rear bearing
- O16 Low-oil-pressure switch

Fuel system

- F1 Fuel-delivery connection
- F2 Fuel pump and control unit
- F3 Fuel filter
- F4 Electrical master connection
- F5 Primary and secondary fuel-delivery manifold
- F6 Fuel-injector nozzles (total ten)
- F7 Delivery and return fuel pipes to IGV actuator





The new oil filler is conveniently located

The solution appeared in the form of the 131-3 APU which AlliedSignal had developed for the Northrop B-2A Spirit bomber. The company saw that the high bleed-airflow needed to start the V2500, at around 1.15kg/s, could be produced by using a downsized version of the load compressor from the B-2A unit.

Similarly, a new gearbox added to the tried and tested engine would satisfy the increased generator requirements. MDC's call for engine performance rated at 10% deteriorated conditions could be met by increasing the power-section output and increasing the exhaust gas temperature (EGT) margin. A renewed scrutiny of durability would help keep costs down to new levels.

In short, by scaling down the 131-3 to 92% of its former size, AlliedSignal found what it considered to be the perfect answer without the costs and risks of developing a brand-new product. "If we had needed to develop a new centre-line [APU core], it would have been twice as expensive. This way there was a factor-of-two difference in development costs," says Rhoden.

The emerging family benefits of the 131-9, as the proposed APU was called, were not lost on AlliedSignal. In the early 1990s, all three big manufacturers were planning further stretches of existing narrowbody aircraft. The development of the MDC MD-90 from the MD-80 was being matched at Airbus with the A319/320/321/322 programme and at Boeing with the next-generation 737-X family. AlliedSignal realised that, with some good planning, the 131 could be the right APU at the right time. "It was our strategy to put this APU with all three of the OEMs. We had to get that to support the case for the 131-9(D) in our company's business plan," Rhoden says.

VARIATIONS ON A THEME

The 131-9 is a single-shaft unit. The power-plant has a single-stage centrifugal compressor and two-stage power turbine, driving a single-stage centrifugal load-compressor and an aux-

iliaries gearbox. AlliedSignal's drive for greater reliability goes right to the heart of the unit: the core is mounted on just two main bearings instead of the usual set of four. The shaft is supported aft of the turbine assembly by a roller bearing, and forward of the load-compressor by a duplex set of ball bearings.

"That's one of the areas [where] we have been able to reduce parts and thereby improve reliability," says Rhoden. The forward load-compressor bearing turns at just under 50,000 RPM. The ball bearings are made from M50 steel and are arranged to take "bi-directional" thrust loads. The bearing has to cope with a wide variety of thrust loads, depending on demands placed on the load-compressor. Whereas loads on the shaft from the power unit are relatively constant, the thrust from the load-compressor varies, depending on whether the variable guide vanes which control the flow of air to the compressor are open or closed.

"If the loads get too light, the bearing can 'skid' as it goes around instead of rolling. So, to keep the balls rolling during minimum-thrust loading, we developed this duplex bearing," says DeRudder. The two bearing races are separated by a spring, so that one pre-loads the other, thus preventing skidding. "It's a good solution for engines of this type where you have multiple stages on one shaft," DeRudder adds.

Aft of the duplex-bearing assembly is the load-compressor. This is slightly smaller than a direct-scaled version of the load-compressor in the B-2 APU, because the pneumatic and electrical requirements of the MD-90 differ. The B-2 APU has a 5:1 pressure ratio, and all of its power is directed into the bomber's pneumatic system. Only two-thirds of the 131-9's power is devoted to pneumatic supply, with the remaining energy being channelled to power the oil-cooled electrical generator. The smaller load-compressor on the 131-9 therefore has a pressure ratio of 4:1.

The space between the load-compressor and the engine-compressor is occupied by a perfo-

rated inlet plenum, the first such application on a commercial design. "It's basically part of the external structure, with a screen built into it, and it gives us performance and acoustic benefits," says Rhoden. The perforated lining of the plenum acts as a diffuser which gives a more uniform air flow into the engine compressor. "That's always been an issue, to try and get optimum flow into an APU," adds DeRudder.

The engine compressor is a relatively large single-stage centrifugal unit. "We can get about an 8:1 pressure ratio with a single stage of compression, and that's good for fuel consumption," says Rhoden. A two-stage compressor would have meant more parts, and an increase in the size of the whole engine, he says.

Air from the compressor is fed into a stacked-ring reverse-flow annular combustor, which owes much of its design to influences from the B-2 APU and the 331-500 used in the Boeing 777. The combustor "...has been developed a little bit more," says DeRudder, to give lower combustion-wall temperatures, down to around 730°C. "You're typically lucky to get 815°C. The pattern factor [distribution of intense combustion] is basically better with this design," he says. "The biggest credit for that goes to the tools and the way we used them," says 131-9 engineering team leader, Tom Bennett. "Using a technique called viscous flow analysis [similar to the computational fluid dynamics analysis used for aerodynamics research] we were able to develop an improved pattern factor. In the past, we'd have gone through 50 to 60 rig tests to develop it. This time, we took substantially less time."

HOT ALLOYS

The combustion gases enter the two-stage turbine section via a first-stage stator, with 22 vanes made from MAR-M 247EX alloy and arranged in 11 two-vane sections. The 36 first-stage turbine blades, made from directionally solidified MAR-M 247DS, are carried on a high fatigue-strength PM (powdered-metal) Astroloy disc. The 31 second-stage stator vanes are made from Inconel 738LC (which is highly resistant to high temperatures and stress-rupture) which are Aluminide coated. The second stage, 32-blade turbine, made from low carbon Inconel 713LC, is integrated with a PM Astroloy disc.

The hot section of the 131-9 is designed to withstand turbine inlet temperatures (TIT) of 990°C and an EGT of 605°C (likely to be encountered when it is powering the MD-90's two-pack environmental-control system, or ECS) when new. After deterioration, the unit will be expected to continue providing 1.1kg/sec bleed flow at a pressure of 3.42 bar (50lb/in²), but will have a TGT and EGT of 1,013°C and 625°C, respectively.

Temperatures encountered during main-engine starts, with the APU producing 67kW (90shp) of electrical power concurrently are, not surprisingly, a little higher. The TIT limit is set at 1,027°C and EGT at 626°C, whilst the APU is generating a bleed flow of 1.15kg/sec

at 3.8 bar. Temperatures after allowable deterioration are expected to climb to 1,050°C TIT and 646°C EGT. Deterioration is also expected to lead to a slight increase in fuel consumption, which should rise during ECS operations from 128kg/h in a new APU, to 130kg/h. Similarly, fuel consumption during main-engine starts will increase by 2.3kg/h to 140kg/h in an older unit.

Externally, the most visible difference between the 131-9 and its slightly larger predecessor is a very flat cooling duct running along the top of the engine from a gearbox-driven fan to the oil cooler mounted near the turbine exhaust. This (far from ideal) feature was the only negative result of the ingenious packaging needed to shoe-horn the 162kg APU into the MD-90.

"The biggest thing we worked on, other than performance, was a big packaging concern," says Bennett. "Basically, we were dealing with the same space as [in] an MD-80, but we had to put a bigger, more powerful APU into the same 30-year old enclosure. It was quite a challenge."

Another influence on the external appearance was the location of many of the external line-replaceable units (LRUs). Some of these were re-packaged, mainly in response to inputs from Delta and Alaska Airlines. "They were heavily involved," says Bennett, adding that the demonstrated maximum removal time for all gearbox-mounted LRUs, such as the lubrication module, is down to 12min.

Access to the lubrication module, fuel control and cooling fan were particularly improved in the 131-9 gearbox design. This also gives easier access to the starter motor and 12,000RPM generator without the time-consuming need to

remove other LRUs. Other traditionally troublesome units, like the air/oil separator carbon face-seal, can be replaced without removing the gearbox, as in previous designs.

"LRU placement was highly driven by the airlines which were looking for much better accessibility from underneath, and lower removal and replacement times," says Bennett. AlliedSignal's accessible APU design means that the 131-9 has a claimed average LRU swap-out time of 7min, or some 73% less time than the equivalent removal and replacement time on earlier engines. The designers were helped by some changes to the basic MD-90 design: "In particular, we have got a big access panel on the MD-90 for the removal and replacement of the inlet guide-vane (IGV) actuator," says Bennett.

In some cases, the airlines influenced the shape as well as the location of LRUs. "The biggest thing that was adapted by the airlines was a new gravity oil-fill system. We used to have a small cylindrical unit and they came up with a large rectangular filler which can support a 1litre [0.26USgal] oil can," says Bennett.

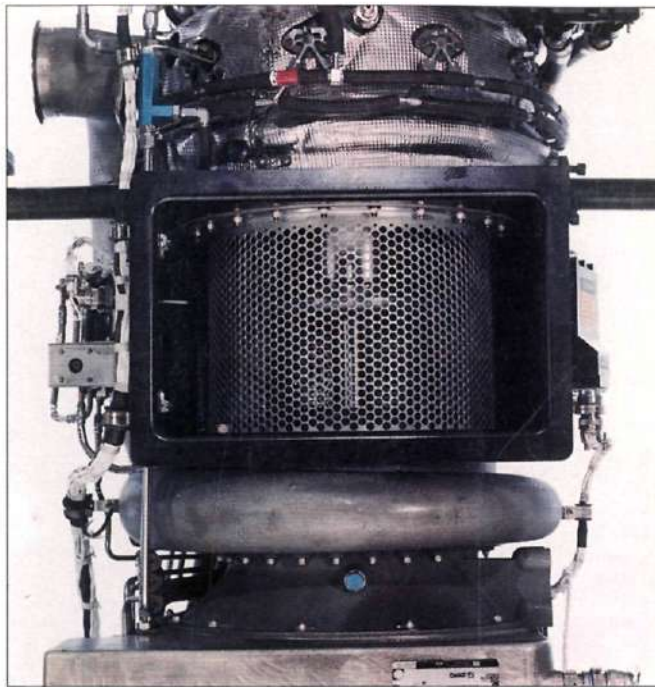
The oil filler is located on the new gearbox, which is based, in part, on the proven design of the 331-500. The gearbox provides drives for the cooling fan, starter motor, lubrication module/fuel control and the generator. The gear train is centred around a high-speed pinion running at more than 48,000RPM. This drives a large compound idler which rotates at up to 13,740RPM and drives the cooling fan, lubrication module/fuel control and starter-motor shafts. The central pinion also connects directly to an idler which drives the generator shaft at just over 12,000RPM.

The "wet-sump" gearbox is enclosed in an aluminium thin-wall casting, and does not require pressurisation for the MD-90's planned operational ceiling of 37,000ft (11,300m).

TESTING TIME

The 131-9D (D for Douglas Aircraft) APU programme was launched in May 1991, and testing of the first engine began on 28 April, 1992. "Alaska Airlines suggested we take it up to Fairbanks," says Rhoden. "The advantages were twofold for us. We got a lot of cold testing in the winter and 3,000h of accelerated endurance testing over the summertime when dust makes it a harsh environment."

In the winter of 1993, the APU was subject-



Perforated plenum serves engine and load compressors

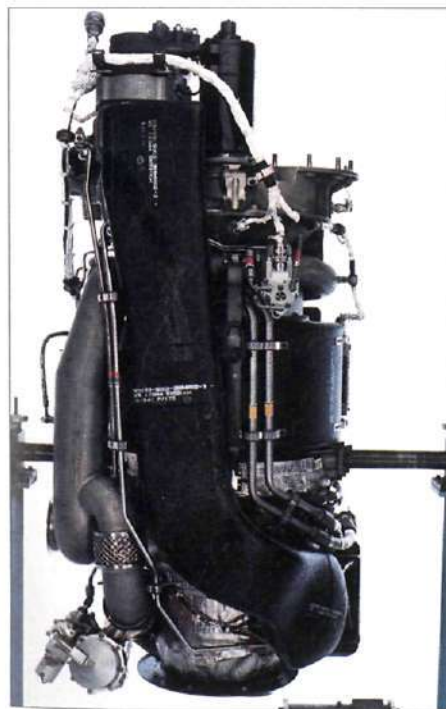
ed to cold-soak tests in Alaska and "...it started every morning after 6-8h of cold soak," he says. After its endurance runs, the engine was stripped and inspected. "The hot section looked beautiful when it came back. Where once we'd have expected minor cracks in the combustor, this time there were none."

Not all was perfect, however, and tests revealed some problem areas. Improvements were needed to the fuel control and cooling fan. The sealing and coating of the load-compressor inlet guide-vanes also suffered from worse-than-expected abrasion from dust and debris, and had to be improved. Similarly, wear and longevity problems in the surge valve were discovered. These were tracked to a weakness in the surge-valve diaphragm, which was corrected with a new design. That new design was given another 1,000-cycle endurance test.

To date, AlliedSignal has amassed around 8,000 test hours on the 131-9. Operational hours are starting to build steadily as MD-90 flight hours mount up and production gathers way at Long Beach, California. AlliedSignal plans to have a total of 14,000 test hours under its belt by the end of 1996, when the first 131-9(B) is introduced on the next-generation Boeing 737. The company ultimately hopes to bring its engine test hour tally to 18,000.

Meanwhile, the urgent business of delivering APUs to the marketplace has begun. Three flight test 131-9(D) engines are in service with MDC, which has also received the first four production APUs. One has also been shipped to Delta as a spare to support the MD-90's entry-into-service in early April.

As the 131-9 enters service, AlliedSignal will be ready for any problems. "We're working hard to make sure that if there are any issues, we'll identify them quickly," assures Rhoden. □



Oil cooler duct dominated view from above



The experimental CDU's touch-screen may be replaced because of its sensitivity

Touch and go

Time is becoming a critical factor in air traffic control.

HARRY HOPKINS/BOSCOMBE DOWN

Research and planning for more efficient European air traffic control (ATC) in the next century emphasises the precise use of the fourth dimension: time. The UK Defence Research Agency (DRA) at Boscombe Down, in Wiltshire, has continued studying this since the middle of 1994, when it was awarded a three-year, £4.5 million extension of its UK Civil Aviation Authority contract to investigate the airborne aspects of "4-D" navigation.

It is intended that enhanced flow management and future reductions in separation over Europe will be supported by high navigational accuracy and continuous communication. To this end, installation of Mode-S secondary radar and its two-way datalink should be complete over most of Europe in 1998, with a full datalink service in place by the year 2002.

I went to Boscombe Down to test 4-D navigation in the DRA's experimental BAC One-Eleven 200 and was given a taste of things to come in the aircraft's future cockpit. A research electronic flight-instrument system (EFIS) is

fitted, while a navigation display (ND) and primary flight display in front of the captain are part of an experimental flight-management system (EFMS) and control-and-display unit (CDU) being developed within the framework of Eurocontrol's Programme for Harmonised Air Traffic Management Research.

With the inertial-navigation system running, we initialised the EFMS, via the liquid-crystal CDU mounted on the centre pedestal. This is larger than the CDUs now in commercial use and is covered by a touch-screen. A format such as this can be programmed according to the flight phase.

Because a touch-screen is sensitive to an inadvertent brush of a hand, other EFMS control combinations being considered include a pressure-sensitive pad, roller-ball cursor-control of the EFIS display and direct voice input.

Aircraft data were keyed into the CDU, while the route was constructed in the EFMS, together with a target-altitude profile, so that a total "trajectory" was calculated.

A plan view of the route was displayed on the ND. Switching it to "profile" allowed the vertical path's cross-section to be shown — from standard instrument departure (SID), up to cruising level and from top of descent (TOD) to destination.

Trajectory-clearance "negotiation" with ATC was carried out through a simulated

Mode S datalink. I selected the next line on the CDU (which acts as a "conversational" scratch-pad between cockpit and ATC) and our flight plan was transmitted for ATC approval. This was given, confirming both trajectory and timing. Activating the plan confirmed the route in the EFMS and automatically notified activation to ATC.

As a taste of the silent cockpit, the "call" for start-up clearance was input by tapping a guarded "button" area at the top of a second touch-screen suspended from the glareshield, simulating a VHF datalink. The clearance message was displayed, then accepted with a touch on the legend. The legend then cleared, giving local control an acknowledgement.

I had already "received" the current airfield data on this screen: three pages, each having ten cues for individual airfields to call up Volmet (continuously broadcast weather reports). A printer at the rear of the console prints clearances and weather.

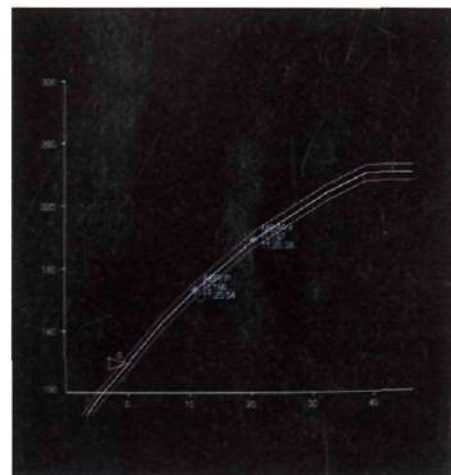
When the engines were running, a second button was touched, and clearance to taxi to runway 23 at Boscombe Down airfield was quickly displayed. The airfield taxiway chart then appeared automatically on the ND, with our position (derived from the differential global-positioning system) shown as a yellow point. The ND reset itself upon receipt of take-off clearance, and we folded away this secondary clearance panel.

After acceleration to a clean configuration take-off, autopilot engagement also selected automatic thrust. Lateral navigation mode captured the route and vertical navigation was armed, to initiate a route climb profile from 4,000ft (1,250m).

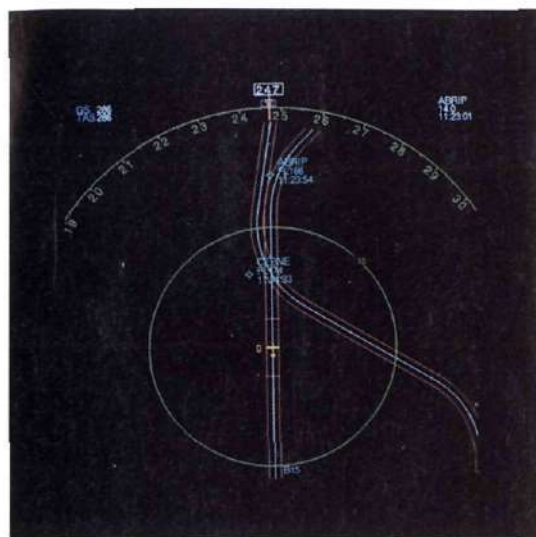
NARROW ROUTE

The white route line is shown on the ND, embraced by parallel yellow lines, set for test purposes at 0.8km (0.5nm) each side. The lines appear upon activation of the flight-plan. Two brackets, ahead and behind, define a time limit "bubble" within the trajectory "tube".

The tube is defined vertically, on the profile display, by similar yellow limit lines about the



Aircraft position in this climb is arrowed



The aircraft symbol is on-track/on-line. The crossing track shows on the return leg

climb path: 1,000ft above and below for the climb, 200ft in cruise and 500ft in descent. The present-altitude symbol is at the profile bottom during the climb. To make scanning easier, it is central in the cruise, and at the top in descent.

To see the narrow lateral boundaries clearly during the SID, I selected minimum scale on the ND. Full-time display of the limit lines at all points of the route seems unnecessary, however.

The limit lines are variable and will be kept as wide as possible, according to the congestion of local airspace. The minima chosen will be based on type-performance accuracy, experience and airspace available. Each bubble of airspace will have a safety envelope of further undisplayed margins about it. Any position within the displayed bubble is acceptable.

The pilot is now aware of time in seconds, rather than minutes — tens of seconds, anyway. The CDU shows cross-track, altitude, speed and time errors. Seconds of deviation are shown against the aircraft markers, on both the route and profile displays.

Each ND way-point is tagged with name, planned altitude and time to the nearest second. A regular EFIS-type display could become cluttered with navigational aids or airfields and weather overlaid, so this format will be reviewed. A larger-format EFIS, showing data for the next two way-points along the ND top edge, would be easier to read.

In-flight negotiations proposed by ATC are highlighted on the ND. At one point in our flight, the EFMS CDU displayed an altitude constraint — 22,000ft (6,700m), crossing an airway, before we were allowed to continue our climb to 24,000ft. On acknowledgement, by a touch on the CDU, our flight plan was “regenerated” instantly, ready for confirmation. The plan is

always regenerated at the start of the cruise, to ensure target times. Should the requested cruise regime be already near to maximum Mach number or ceiling, compliance will not be possible. The EFMS then responds with a “best-fit” response to an ATC proposal for increased altitude or earlier time.

We then processed a further ATC request, for earlier arrival at our destination. An advance of 45s lifted the indicated airspeed, from 250kt (460km/h) to 275kt on acceptance. Throughout, time error rarely exceeded a couple of seconds, but this will be relaxed to reduce auto-throttle activity.

We had headed into a wind of 330/75kt; the EFMS had to take account of a reversal of wind component as we turned about and the airspeed decreased again. Even with this large change in wind component, the aircraft tracked the curved route as though on rails.

Future ATC will take account of severe route weather and wind variations. Evaluation of the potential of “perfect” forecasts, and automatic downlinks of wind velocity and temperature, is taking place through the UK Meteorological Office. A whole “grid” of data from points over a large area could then be automatically transmitted to the EFMS.

It is important to keep to schedule, right up to the “metering point” — where the flight enters terminal airspace. Here, the flight plan was again regenerated, to establish a more precise TOD.

CONTROLLED DESCENT

The EFMS still controlled our airspeed but, to meet schedule, the descent-path profile is varied by power. With a stronger tailwind than planned, this could not quite be achieved with idle thrust, so when we were 600ft high on datum I edged out a little speed-brake until the auto-throttle levers advanced again.

With higher power — for example, when all de-icing equipment is on — such adjustment might be needed. With a conventional EFIS, having a profile deviation scale and “add-drag” flag, profile monitoring would be less frequent.

The microwave-landing system (MLS) datalink might be used on approach, but at the moment data cannot be received omni-directionally from its transmitter. It is not

vital, however, because a high-integrity updated stand-alone EFMS database is already part of a 4-D traffic system.

The transition from EFMS control by air data to joining an MLS profile is progressive and blended.

At 5,000ft, downwind to the north of

Ground-to-air control

The need to put many more aeroplanes safely in any given airspace sector implies smaller separations and much greater flying accuracy in all four dimensions, including time. That can be achieved only by pre-programming air-traffic-control computers with the aircraft's flight plan, and having the aircraft's flight-management system (FMS) continually feed back its performance, position and the crew's intentions through datalinks.

The ATC computer can correlate that feedback with similar data from other aircraft in the sector, and uplink corrections or amendments to the aircraft's trajectory for input direct into the aircraft's FMS after they are “accepted” by the pilot.

Pilots can downlink to ATC desired changes in trajectory, entered into the system via the control and display unit. Once those changes are cleared or amended by the ATC computer, they are uplinked for acceptance by the pilot and entry into the FMS.

The navigation display is similar to a standard one, but the waypoints are annotated with precise times, and acceptable deviations from the ideal 4-D trajectory can be displayed (as described in the main text).

Boscombe Down, our airspeed reduced to 200kt, as in the EFMS plan, and a 90° turn was made at the approach point. From there, an MLS-defined path of two segments took us to join the runway centreline and then capture a 4.5° glide-slope. Coupled approaches on a continuous MLS curve are part of the programme.

After the approach gate, the pilot is free to continue to reduce speed and reconfigure the aircraft. ATC will be relying on normal approach routines and closely observed speed schedules.

The autopilot held speed and descent slope well in a gusty 25kt cross-wind as our landing clearance was transmitted to us. I disconnected the autopilot at 1,000ft, to increase descent rate and recapture a normal 3° visual-approach slope. I forgot, however, that this disconnects the auto-throttle too, so 15kt was gained before speed was re-stabilised for flare to a landing in a 15kt cross-wind. Once the aircraft was on the ground, the airfield chart re-appeared on the ND and our yellow position dot led us back to the parking area.

If Europe proceeds with a concept like this, not only would the cockpit have evolved further into the electronic age, but the terminal area controllers will be like the pilot — monitoring only. The accuracy of the trajectory would mean there is little need for radar vectoring and virtually no need for voice exchanges. □

“Other EFMS control combinations being considered include a pressure-sensitive pad, roller ball and direct voice input.”

Flight International flight tests Eurocopter's candidate for the UK attack-helicopter requirement.

PETER GRAY/MUNICH

Everything about the Eurocopter Tiger is modern — the design, materials, the technology and even the way it is operated and managed. The rotor head has no hinges to lubricate and is made of composite materials. The main rotor blades are also made from composite materials, and especially at the blade tips, are of modern design. The tail rotor, too, is modern in design and materials. I recognised it as being similar to that of the Aerospatiale Super Puma, but with three blades. It is very powerful, as I was to find out.

All the gear boxes have a dry-run capability, the main gearbox for 66 min. The MTU/Turboméca/Rolls-Royce 390 engines are prototypes also, so we had to be careful. Visitors like me are not yet allowed to do single engine landings. I did, however, examine a reversion to single engine in the cruise. The engines produce a huge amount of power — 1,160kW (1,550hp) "super emergency power" and 958kW each for take-offs — yet they weigh only 170kg.

The Tiger, like all the other combat helicopters, has a high power-to-weight ratio. What I found remarkable is that the modern engines can produce the same, or even more power than, their predecessors, but weigh a lot less. Gone are complex axial compressors and their complex variable air-inlet guide vanes, which are fine when everything is well adjusted, but can cause dramatic power losses and other undesirable characteristics when they go wrong.

Instead, with this engine there are two very powerful centrifugal compressors of modern shape, design and materials pouring the power into just a single gas-generator turbine. Their robustness reminded me of operating in primary jungle clearings in South America, where our centrifugal compressors would suck in all sorts of bits and pieces of undergrowth and vegetation and spit them out at the back with no ill-effect. The engineers were convinced that they gave the engine a clean-up on the way through.

After a pre-flight study of the flight manual, and other documents and a long question and answer session with Andrew Warner, Eurocopter's chief test pilot and Tiger project pilot, and Manfred Kaminski, flight-test engineer in charge of the Tiger, I was ready to fly.

WALK AROUND AND START-UP

The weather was fine, with a gentle breeze, plus 7°C air temperature, and a pressure and density altitude of about 2,000ft (600m). I had

asked for a heavy aircraft, so Warner chose 5,700kg, which would be a representative weight after taking off at the maximum of 6,000kg with the appropriate weapons and fuel for the job to be done, and arriving in the vicinity of the first target or targets. We spent a long time going round the aircraft. I was aware of the various design philosophies and saw now how they were achieved.

The first of these is "Do Not Be Seen By The Enemy". So there is the very thin fuselage with 1.1m-wide cockpits, the signature-reducing paint, no glare from the large areas of cockpit glass and plexi glass, the infra-red/TV sight right on the top of the main rotor to allow the rest of the helicopter to remain hidden, the diffused engine-exhaust gases, low-radar-signature blades and low overall noise.

Also apparent were the measures taken to satisfy the second criterion of any combat helicopter — "If Seen, Do Not Be Hit". Dotted around the fuselage are devices for detecting laser and radar illumination, and alerting the crew. The aircraft's agility, with its limits of +3.5g to -0.5g, also helps it to stay out of trouble.

Another of the design criteria is: "If Hit, Survive The Impact And Stay In The Air". For example, the tail-rotor drive-shaft on a commercial aircraft of this size would normally be about 40mm in diameter and of solid metal. The Tiger's horizontal drive shaft is made of aluminium alloy; the inclined drive shaft is made of composites.

If hit, by even a small-calibre round, it will easily shear, giving a severe, often fatal, control problem. On the Tiger the solution, brilliantly simple but effective, is a hollow composite shaft of almost 130mm diameter, through which a round can pass without necessarily fatal damage. The load will pass around the resulting two holes and the shaft will continue to drive the tail rotor. The engines,

too, are designed with the same philosophy — that is, in one side, out the other and contain the damage. They are separated, however, by an armoured bulkhead to protect the remaining engine after a failure.

Finally, if it is one of those days and a crash is inevitable, the designers and manufacturers

Riding the T

"The designers and the manufacturers have made a real effort to protect the crew."

Flying at low level over Ottobrunn, southern Germany. Getting started (below)



iger

have made a real effort to protect the crew. The rearward-sloping main undercarriage legs will contain an enormous amount of vertical speed impact; likewise the aircraft belly and the crew seats. The cockpits are strengthened to protect the crew should the aircraft roll over. Each crew member has a window-jettisoning system, which blows out the appropriate panels on either side. The panels can also be blown out by an outside rescuer — a nice touch.

The main gearbox and engines have containment so that components do not penetrate the cockpits, a lethal occurrence with older-generation helicopters. The fuel tank is self-sealing. There are cable-cutters top and bottom, essential for low-level nap-of-the-earth flying. The horizontal stabilizer also serves as a work platform. We noted, too, the good lightning protection, plus the gravity refuelling point on one side and the pressure refuelling point on the other. The aircraft can be refuelled and re-armed in the field in less than 20min by three men.

With all these reassuring factors in mind, I climbed up eagerly into the front cockpit, which is for the pilot. I looked around and



liked what I saw. Eurocopter has eliminated as many switches as possible. What remains are just a few on each side panel. The engines are full-authority digitally controlled — that is, fully automatic, so there are no twist-grip throttles or speed-select levers, just a small single management panel on the left-hand console which does it all.

Engine management is straightforward, foolproof and simple. I noted the usual scratch-pad liquid-crystal-display (LCD) screen and associated keys to change, update or enter new information. The instrument panel is dominated by two 150 x 150mm multi-function displays (MFDs), which show everything that the crew requires at the appro-

priate time to operate the aircraft, including navigation information, check lists, emergency procedures, a moving map and weapons information — not only yours, but those coming at you, along with other useful and vital items.

I was impressed by the fuel-contents-versus-range management: the pilot can programme the system for ground speed, track or other parameters and he will then be given the amount of fuel/time remaining to complete a task and other bits of useful fuel information.

MFD presentations can be selected in metric or imperial units. The crew will be alerted automatically of any malfunctions or necessary warnings such as low fuel — orally for most of the malfunctions and warnings, and also visually. One of the MFDs will identify automatically the problem and suggest corrective action. The alerting system is geared to the severity of the problem.

The rest of the cockpit equipment is strategically placed in a logical, sensible fashion, giving a well-designed and functional layout in a fairly confined space. To allow the pilot to look out and fly the aircraft (the most important quality of a combat helicopter), the important systems can all be managed using the devices on the cyclic stick and collective lever. There is a set of standby conventional analogue flight instruments alongside the MFDs in the front cockpit. The small wide-angled mirrors on both sides of both cockpits allow the front crewman to observe the rear one and both to view the rear of the aircraft.

For the flight, I occupied the rear cockpit, designed for the gunner. The aircraft can be flown from either cockpit — the controls are identical. The gunner has access to all the sighting and sensing systems and weapons including the Tiger's primary armament — the TRIGAT fire-and-forget anti-tank missile. The pilot in front can fly everything except the anti-tank weapons, and has access to all the sensors.

For really rapid departure, the crew can get into the cockpit, select "start" on both engines simultaneously, then strap in. By the time they have done this, the engines and rotor are at flying speed, the avionics are self-tested and on-line and you are ready to lift-off — after engaging the automatic flight-control system if you wish.

We, however, did things slowly. The left-hand engine was started, showing benign acceleration and temperature peaks — no drama here. With this running, we were able to use it to give us hydraulic power and full electrics to check out all the systems. Full and free movement of the controls was performed using the auxiliary hydraulic pump before the start of the first engine. I noted that the cyclic stick has a relatively small range of movement because there is a large amount of power available to the rotor with only a small amount of cyclic movement. The number-two engine was then fired up, the warning system showing us that everything was on line and serviceable. I pulled up into my first hover.

FLIGHT TEST

TAKE-OFF, HOVER AND CRUISE

I deliberately relaxed both arms and feet as we lifted off. There were no surprises, and we came to a neat hover. I noted from the power indicator on the MFD that we had plenty of power in hand. The aircraft is designed to have at least a 17% power margin when hovering out of ground effect.

Warner took over briefly and gave the official photographer some unusual hover attitudes: 20° nose down; nose up; 45° left and right back. I resumed control and tried the usual hovering manoeuvres of sideways, backwards and spot turns, with and without the duplex four-channel automatic flight-control system (AFCS), stabilization-augmentation system (SAS) and trim-augmentation computer. The latter is a special handling augmentation system for nap-of-the-earth flying to give better handling at moderate speed.

These manoeuvres were to be repeated later to the aircraft's limits, when we had more space. The message which came through loud and clear was of the effects of a rigid four-bladed rotor and 10% equivalent offset hinges. They give an outstandingly stable aircraft, even with all the stabilisation systems off — and there are three levels of automatic stabilisation. The Tiger hovered almost hands-off: I merely held the stick and lever very lightly, did nothing with my feet and just gave the occasional suggestion of a push-pull on the controls. The hover was rock-steady. Vibrations were benign, visibility was superb and I felt comfortable and relaxed.

Eurocopter has made a big effort to provide the crew with a comfortable cockpit. The environment system should deal with most extremes of weather, and the seats are comfortable and adjustable, so that you can see the top line of the instrument panel display (this is important because there are warning lights here) and over the 21° drooped nose. From the



The pleasantly uncomplicated cockpit is dominated by two multi-function displays

rear cockpit, the gunner can see over the occupant of the front cockpit and over the nose.

Best of all, from a handling point of view, is good control, especially with the cyclic stick. This is so important in combat helicopters with the enormity of their combined tasks of staying low, going very fast, identifying the target, firing at it and staying out of harm's way. The cockpit is so designed that I could find a position where I could rest my right forearm on my right thigh and thus achieve extremely accurate handling. The small cyclic movements give vast rotor-control power, allowing precise, but relaxed control of the helicopter.

I pulled maximum continuous power and we shot out of Eurocopter's small operating area and into the cruise. While we were still fairly heavy, I held maximum continuous power to check the speed. We were at 5,000ft pressure altitude, slightly over 5,000ft density altitude in slight turbulence. We got 140kt (260km/h) indicated air speed, 150kt true speed. The brochures say 145kt sea level, so this was quite close. While the Tiger was still quite heavy, I pushed over and went to the published V_{NE} of 160kt. The aircraft specification calls for 160kt for our configuration. The air-to-air and ground-support version goes to 170kt. Given the sophistication of the main-rotor system, I was curious as to how fast Eurocopter had actually flown the Tiger. "Much faster," said Warner. There was a slight increase in the low vibration level as we passed through 150kt, but nothing significant. I rolled left 30°, and snapped over to 30° right again. All the responses were benign. Warner gave me a few system failures so that I could assess the warning systems. Pitot-head failure pro-

duced a mild gong and warning lights. I asked for the more serious situation of a generator failure (loss of nearly 50% of electrical power): the warnings were the same, but the MFD showed us the situation automatically. More serious events, such as high/low-rotor RPM, have an even more urgent attention-getter.

AUTO ROTATION

Next, we entered auto-rotation with a powered recovery at the bottom. Auto-rotation characteristics are a minor consideration for a combat helicopter, which will rarely be at such a height as to be able to take advantage of it. No test pilot report is complete without one, however. The best rate-of-descent speed of 70kt gave us a rate of descent of 2,600ft/min (13.2m/s), which is to be expected in such a helicopter.

Helicopter performance, like many things, is a compromise between adequate or (better still) more-than-adequate rotor power available to the pilot to do the job, and having a benign rate of descent in auto-rotation. The plus side is that, although Eurocopter has not yet carried out engines-off landings, I strongly suspect that when it does there will be more-than-adequate rotor power available to achieve a successful benign landing.

Having by now got used to interpreting the power parameters on the MFD, I explored the effects on the rotor RPM (NR) on raising and lowering the lever quickly. With a poor system, you can get an unwanted loss of NR just when you need high RPM most.

The readability and interpretation of the MFDs was excellent: the only slight niggle I had was that the engine torque representation did not identify which needle applies to which engine. Warner agreed, and said that he would get it changed.

Flight through very mild turbulent air coming off the snow-capped Alps gave sudden mild attitude disturbances that were easily controlled. I was now flying the aircraft raw with no stability augmentation.



The Tiger is rock-steady in the hover

BACK TO LOW LEVEL

Eurocopter has clearance to fly low in this zone, so we dropped down to a large open area to explore the limits of sideways and backwards flight, and spot turns. I was allowed by Warner to go sideways in each direction to such a speed as to reach full pedal travel. This resulted in about 60kt, plus or minus 10kt — an impressive demonstration of tail-rotor power and the suppression of other aerodynamic nasties which can occur at these sideways speeds.

There was a very slight rocking as we went through about 20kt, but nothing significant. Fast backwards flight (60kt) was benign. Warner says that he has been up to 70kt: his visibility from the front cockpit looking aft is excellent. Fast backwards flight is not an operationally necessary manoeuvre, but does give the pilot a lot of confidence in the quality of control. The aircraft's specification calls for a 40° heading change after 1s, hence the powerful tail rotor which gives a rate of turn of 120°/s.

AGILITY AND AEROBATICS

As we climbed up, I gave my five-point harness and chinstrap an extra tug and handed over control to Warner for him to demonstrate the Tiger's agility. Accelerating using maximum continuous power, he got up to 120kt in a steep climb and pushed it over the top into a vertical dive. For good measure, he then rolled the Tiger through 180°.

Next came a manoeuvre I have carried out only in an aerobatic fixed-wing aircraft, pointing vertically up until the aircraft stops, kicking it around 180° to point vertically down and then, to demonstrate the rotor power available in this extreme position, do a 180° turn. Very impressive. We then did a couple of loops, pulling 2g.

As I followed him through on the controls, I noted that he did not use a lot of cyclic movements, as you would in a fixed-wing aircraft, thus proving the high rotor-control power with only a small cyclic-stick movement. I noted out of the corner of my eye that, as we became inverted, my MFD artificial horizon toppled but, miraculously, as we levelled out the right way up, it was back to normal.

The next demonstration, which shows the rotor-control power available, was coming to the hover at a safe altitude, and whacking the helicopter over to 90° of bank.

Air-to-air combat is in the specification, and Eurocopter has found that in such a role, with the crew concentrating on keeping the other aircraft in sight, you can get into some very unusual attitudes — hence the Tiger's ability in this area. The rigid rotor, as well as giving superb stability, also gives lots of control power, especially during low or negative *g* manoeuvres. Recovery from unusual attitudes is not a problem.

NAP OF THE EARTH FLYING

We next explored rapid accelerations and then quick stops from the hover, followed by a low-level run below the treetops. The rotor disc diameter is intentionally small, at 13m (the

Technical details

The Tiger comes in three configurations — combat support, anti-tank and support (does everything). As well as the sight on the mast, there is also a thermal imager, a helmet-mounted sight display (both crew), a TV camera, laser range-finder, missile localiser and night-vision goggles. (Everything in the cockpit is compatible with these.) Both crew have access to all the sensors.

Besides its primary anti-tank missile armaments, the Tiger's armaments include anti-tank missiles, HOT or TRIGAT, unguided rockets, 12.7mm gun pod, Stinger missiles, Mistral air-to-air missiles, and a 30mm turret-mounted gun (capacity 450 rounds). Some of the weapon attachments on the stub wings are steerable. All weapons are passive.

Systems performance, exceedances, malfunctions and other factors are recorded and the maintenance crew has access to these. The aircraft has been designed to be operated in the field by unsophisticated maintenance personnel. Maintenance tests have been carried out to ensure that tasks are done within a certain time. All aspects of a mission are placed onto a cassette before the flight: this is then fed into the aircraft's computers, which programme the systems accordingly. The crew can modify this information using the LCD scratch pad. The aircraft is protected against electro-magnetic interference in excess of anything that a battleship can produce, so the aircraft can be safely deployed off shore. The aircraft is well below limits for ground resonance to occur. For vortex ring to develop, entry conditions have to be exact. There is lots of control power available to recover.



The primary anti-armour weapon, the TRIGAT

Bell SuperCobra's is 14.6m and the Atlas Rooivalk's is 15m). The aircraft can therefore be taken through very narrow gaps and is very agile around the 90° bends.

With its mast-mounted sight, the Tiger can hide behind an obstruction, preferably solid, and the hover hold is engaged using the Doppler and radar altimeter. The gunner looks through the sight on top of the mast, and can take the helicopter up so that he can see the target. Only the sight is exposed, the rest of the aircraft remains masked.

He can then take the aircraft back down, sort out the weapons and pop up again to fire them. He can fire four anti-tank weapons in, say, 4s — the total exposure time of the aircraft. It would be extremely unlikely that the enemy would see the Tiger. The mast-sight vibrations have been suppressed to within the specified limits.

If the cannon is to be used on a target which is not on the line of flight (it can be pointed at least 90° either side), the resulting powerful kickback is prevented from rocking the aircraft by the automatic flight-control system. This receives signals, before the first round has gone out, of the angle, direction, rate of fire and other parameters to kick the heading of the aircraft to point directly at the target before the first round actually leaves the gun. Hence the powerful tail rotor.

We returned to base and I carried out a steep approach on to the H: visibility from the rear cockpit looked good. Warner also demonstrated a sloping ground landing: the aircraft was not equipped with the appropriate telemetry for this so he could not take it to the specifica-

tion limit of 12°. The specification also calls for the aircraft to be shut down for up to four days on a 12° slope, so a special braking system has been adopted, to avoid relying on hydraulic brake pressure, which can dissipate.

Finally, we examined a single AC generator failure, followed by a double failure. The warning systems alerted us, although we lost the use of the MFDs. The aircraft was still perfectly flyable, however, using the front cockpit's stand-by instruments. There are two batteries. Shut-down, if necessary, can be accomplished in 30s.

CONCLUSIONS

The four basic Tiger criteria of: not being seen; if seen, not being hit; if hit, staying airborne; if a crash is inevitable; to survive it; were proven to me. Other design parameters, such as HOCAS (hands-on cyclic and stick) were also proven, plus the essential ability of being able to fly the aircraft while looking out the whole time, even at night and in bad weather.

With its light weight, powerful engines and superb flying ability, the Tiger can take full fuel, full air-to-air weaponry and full TRIGAT weaponry and get you to the target and back.

Maximum endurance is 2h 50min, including reserves. Range with the fuel pods is 1,300 km. The aircraft will probably remain unseen and possibly unheard. It is designed to fly in all weathers, except icing conditions, but it has several anti-ice systems, although not on the blades or engines. There is plenty of potential for increasing engine power, or raising weight, speed and other performance criteria. I was impressed with everything I examined. □

TIM FURNISS/LONDON

As James Weatherbee, commander of the US Space Shuttle *Discovery*, brought his orbiter close to the Russian Mir 1 space station on 6 February, he told the station's commander Alexander Viktorenko that he was "...bringing our nations closer together".

How close the nations become depends not just on the technical challenges facing the Shuttle missions sent to dock with the Mir. Perhaps more vitally, they depend on the funding of the two nations' space programmes in the lead-up to the proposed joint Alpha international space station after 1997.

NASA has been told that it must cut \$5 billion from its budget over the next five years. Daniel Goldin, its administrator, says that NASA is being asked to do a lot more for far less and plans to "...revolutionise the agency", making it less of an operational and more of a research and development agency, and one considering the use of "less expensive vehicles".

The expensive Space Shuttle, the operation of which is already under intense pressure from budget cuts, could do without this pressure, especially when it is the major launcher for the Alpha programme and about to be used on the Mir docking flights.

Russia's space budget has also been reduced, to one-fifth of what it was five years ago. The Russian Government is now cutting it by a further 40% to 1.2 billion roubles (\$180 million, at market exchange rates), putting it on a par with India's programme. The Government says that the shortfall will have to be made up from commercial investment.

Yuri Koptev, director-general of the Russian Space Agency, says that his budget problems could "...curtail plans for launching manned spaceflights", and warns of 360,000 space-worker redundancies in 1995.

Veteran spacecraft and rocket designer Yuri Semenov, chief of the Energia company, says that 7,500 of his specialists have already been laid off, and a further 30,000 jobs are in jeopardy because of project cancellations.

Vladimir Ivanov, commander of Russia's military space forces, says that there are not enough boosters to support 75 planned launches in 1995. Many of the 49 (of a planned 102) civilian and military launches in 1994 were accommodated by a reserve of military rockets, which is now almost exhausted. Only seven new boosters were manufactured in 1994.

This financial climate is hardly the best in which to send the US Space Shuttle to the Russian Mir 1 space station in June, for the first of seven planned dockings and US/Russian joint operations over the next two years.

The dockings and operations will form the first phase towards establishing the Alpha international space station, construction of which is due to start in mid-1997, with the launch of a Russian Functional Energy Block (FGB).

The Alpha project is not yet safe. NASA has awarded the formal \$5.63 billion contract to Boeing for the construction of the Alpha, but

that does not necessarily mean that the project has finally cleared the US Congress, although the Republican party favours it more than does the Democratic party. The performance of the *Atlantis* in June will be an important factor.

PARTNERSHIP DOUBTS

Participation of other international partners — the European Space Agency (ESA), Canada and Japan — will depend on their continued goodwill, already stretched to the full by the design changes and budget arguments. The launches of their respective modules and equipment have moved into the 21st century.

The ESA, in particular, is being forced to reduce its space-station budget, and it is not inconceivable that it could withdraw. France and Germany have told it to cut its *Columbus/Alpha* budget by \$2 billion, to about \$2.5 billion, by 2000.

Cost considerations forced the USA and Russia to look seriously at joint operations in the first place. The catalyst was the collapse of the Soviet Union, which made co-operation a sensible option, both politically and financially.

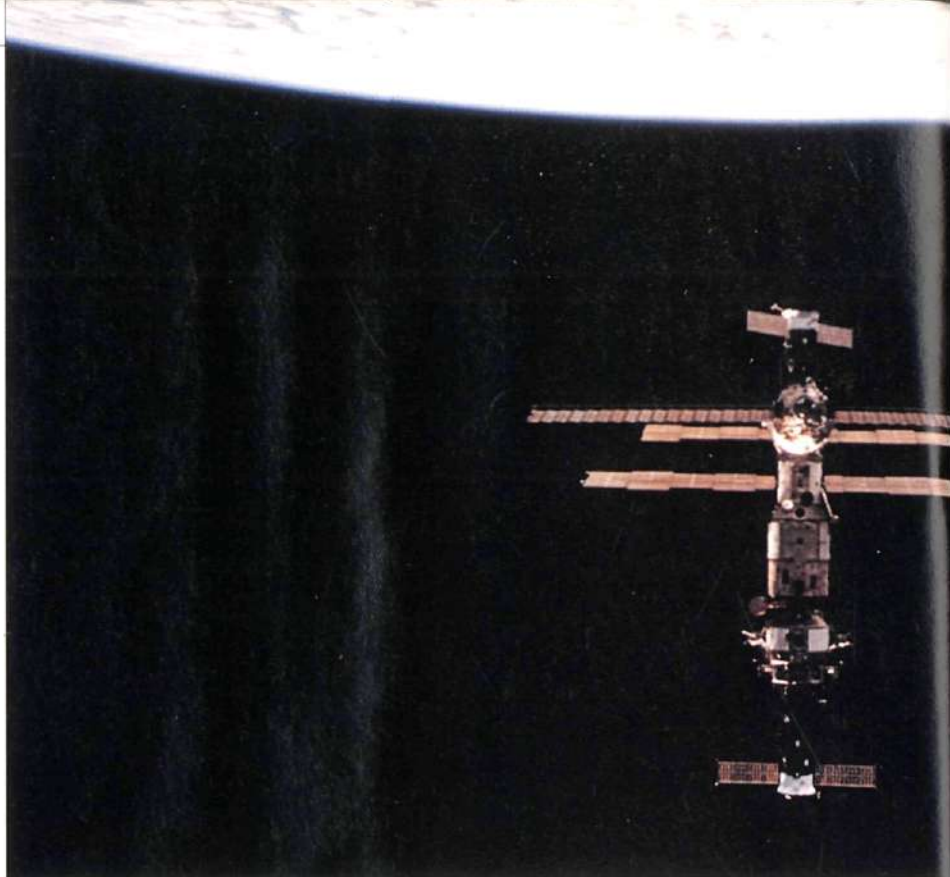
Before the Mir 1 expires of old age, NASA and Russia have an opportunity to prepare for the Alpha operation. Two Russian cosmonauts have flown Space Shuttle missions. US astro-

naut Norman Thagard will be launched on a Russian Soyuz, on 14 March, to stay aboard the Mir 1 for about 80 days. Astronauts John Blaha and Shannon Lucid (the most-travelled US woman astronaut) are training for a second Mir 1 shift in 1996. One will fly. Two other astronauts will make later missions, extending long-duration flight experience for the USA.

The objectives of this Phase 1 co-operation are to help each country learn to work with each other; to understand fully the technical issues, including space-station construction and maintenance and operations; to give the USA long-duration flight experience; and to perform scientific experiments — which will take a back seat in the early stages.

NASA is paying Russia about \$400 million to host these missions, and for the use of the two new Mir modules, the Spektr and Priroda. These modules are to be launched in May and October, much later than planned, and too late to be of much use to Thagard, whose US experimentation will be light.

The Space Shuttles will be used to ferry and return some Russian crews and the US astronauts — only Thagard will get a Soyuz ride. Although science is planned, the crews will find themselves spending a lot of time with logistics and servicing work



Shaky partner

ership

Despite the *Discovery's* triumph, joint US/CIS missions face an uncertain future.

The high-profile flight of STS63 *Discovery* — which was not originally planned to include a Mir rendezvous, and was not part of the official Phase 1 co-operative programme — demonstrated how well US and Russian engineers can work together from their Houston and Kaliningrad control centres, overcoming the challenges of language and cultural and flight-protocol differences.

The STS63 launch in a 5min "window" was a demonstration of the similar routine launches which will have to be made during the Mir docking flights and for the Alpha space station assembly and servicing flights. The actual launch time for the *Discovery* was not computed until later in the countdown, based on latest Mir orbital data. The weather was good for the STS63, and it will be interesting to see to what extent flight rules may be waived in more marginal conditions.

The Mir seen from the Discovery on STS63

VHF communications between the Shuttle and the Mir 1 were demonstrated on the STS63 mission. Communications from a distance of 40km (22nm) are planned eventually, and the Shuttle and Mir commanders will assume more in-flight responsibility and control.

The concern over the two leaking reaction-control thrusters aboard the *Discovery* and the possibility that the nitrogen-tetroxide propellant could damage the Mir's solar panels and optical instruments was an interesting test case for co-operation between the respective flight-control teams. After initially being against the planned close rendezvous, Russia allowed the *Discovery* (with its errant thrusters shut down) to come within 11.2m.

CO-OPERATION BONUS

Brewster Shaw, director of Space Shuttle operations and a former Shuttle astronaut, says that the thruster debate provided an unexpected opportunity for the two parties to "...figure out how we are going to deal with each other, how we are going to operate together, and how we are going to overcome unexpected things that arise in the future. It was a special plus, I think, to be able to do even more negotiation and more co-operation with our Russian partners on this flight than we anticipated".

The piloting of Weatherbee, bringing the Shuttle in towards the Mir, provided vital data and experience to enable the STS71/*Atlantis* commander, Robert "Hoot" Gibson, to go the last 11.2m in June, and very delicately dock with the Mir's Kristall module port, at a speed of just 0.1ft/s (0.03m/s). The Soyuz docks with the Mir at a speed of 0.4ft/s. Photographs and observations taken during the *Discovery* approach and subsequent fly-around of the entire station, from a distance of 120m, will be invaluable.

The docking of two such large vehicles has never been accomplished before. It is acknowledged that it is going to be dangerous. Gibson will have just 4min to complete the docking over a Russian tracking station in central Asia and will have to use a camera on the Rockwell/NPO Energia-built airlock and androgynous docking system to have a clear view of the Mir's port.

The ten-person Shuttle-Mir crew — Thagard and two Russians (Vladimir Dezhurov and Gennadi Strekalov) plus two Russians brought up in the *Atlantis* (Anatoli Solovyov and Nikolai Budarin), together with the Shuttle's own crew (Gibson, Charles Precourt, Ellen Baker, Greg Harbaugh and Thagard's back-up Bonnie Dunbar) will conduct joint work and have the use of a Spacelab laboratory in the *Atlantis* payload bay.

Solovyov and Budarin will be left aboard the Mir and Thagard, while Dezhurov and Strekalov will be brought home as part of an eight-person crew. The only other flight to carry eight was the STS61A/*Challenger*/Spacelab D mission in 1985.

The crew for the STS74/*Atlantis* mission —

to dock with the Mir 1 in October — has been selected. The commanders for the STS76 and 81, scheduled for March and December 1996 respectively, Kevin Chilton and William Readdy, have been assigned. Activities on these later flights will be more complex.

The STS74/SMM 2, under the command of Kenneth Cameron, will carry some US solar arrays to be integrated with those on the Mir 1, to improve electrical generation. Eighty-four of the modules each containing 80 solar cells, will be integrated as 42 hinged-pairs.

Spacewalks are planned for later Shuttle missions. The STS76/SMM 3 has provisions for two astronauts to make walks to mount experiments on the exterior of the Mir 1, while the SMM 5 will include a spacewalk, possibly by one Russian and one US astronaut, both wearing Russian suits. Scheduled for the SMM7 in May 1997 is the world's first four-person spacewalk (two Russians and two Americans) to deploy a solar-dynamics module on to the outside of the Mir 1. This will be the most realistic rehearsal of space-station assembly ever to be undertaken.

Once the FGB has started the Alpha programme, a vacant Mir 1 will be kept alive for another year to 1998, to enable evaluation of the new solar-power system. □



The Discovery heads for the Mir rendezvous



Bill McCourt

■ AIR BELFAST

Dr Bill McCourt has joined the board of new UK airline, Air Belfast. McCourt was managing director of the "Old Bushmills" Distillery until 1992. He was previously general manager at the Rolls-Royce plant in Belfast.

■ ALASKA

Raymond Vecchi, Alaska Air's chairman and chief executive, has resigned because of differences

with the company board. Executive vice-president **John Kelly** has been named chairman, chief executive and president. He will continue as chief operating officer until a replacement is named. Vecchi worked at Alaska Air for two decades.

■ FAA

The US Federal Aviation Administration has appointed **Christopher Hart** to a new post of assistant administrator for system safety. Hart will have overall responsibility for the FAA's safety programmes. Hart was formerly deputy administrator at the US National Highway Traffic Safety Administration.

■ GKN

David Wright has been appointed to the board of GKN, and will succeed **Alan Jones** as managing director for the company's Aerospace and Special Vehicles, with responsibility for the Westland Group and GKN's

Special Vehicles Division. Wright has been chief executive of the Division since 1989, which he joined after 27 years with GEC.

■ AMERICA WEST

America West Airlines has appointed **Barbara Newman** as vice-president, compensation and benefits, and **Stephen Johnson** as vice-president, legal. Newman comes from Avon Products, New York, and Johnson was formerly senior vice-president and general counsel for GE Capital Aviation Services in Shannon, Ireland.

■ FLIGHTSAFETY

Britt Hoskins has been promoted to director of Government business, a new position at FlightSafety International. Hoskins has been the company's manager for its Daleville-Dothan Learning Centers, which primarily train military aircrews, for the past 11 years.

■ PEMCO

Precision Standard of Birmingham, Alabama, has appointed **Cleveland Howie** as director of marketing for the company's Pemco Nacelle Services Unit. Howie was most recently senior sales and marketing representative for AAR Engine Component Systems. The company has also appointed **Lars Kirchhoff** as regional marketing manager for its Pemco World Air Services Unit in Copenhagen, Denmark. Kirchhoff was with Ansett/TNT in Sydney, Australia.

■ SINGAPORE

Singapore Aerospace has appointed deputy chairman and president **Quek Poh Huat** chairman in place of **Lim Hock San**, who steps down from the board. **Boon Swan Foo**, president and director of Singapore Shipbuilding & Engineering, becomes a director of Singapore Aerospace.

■ RAF

Flt Lt **Jo Salter** has qualified as the first woman Royal Air Force "Combat Ready" strike/attack pilot, and has begun operational service with No 617 (The Dambusters) squadron.

■ BOMBARDIER

Gaston Hébert has been named president of the Bombardier Aerospace Group's de Havilland company. Hébert has been executive vice-president of the com-

pany since last November and succeeds **Ken Laver**, who has left to pursue other interests.

■ SIMUFLITE

Marjorie DeLong has been promoted to manager of sales representatives at Simuflite's Dallas/Fort Worth headquarters. She was formerly the company's regional sales manager for the North Central Region, Chicago. **George Black** replaces DeLong in Chicago. The company has also promoted **Karen Montalvo** to manager of marketing services.

■ CANADIAN

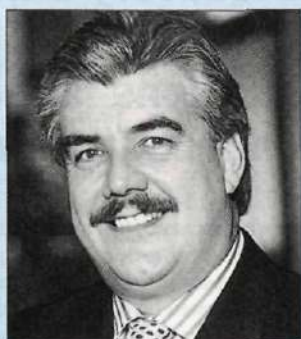
Canadian Airlines International has made **Gill Edwards** its new customer service manager at Terminal 2 at London Heathrow Airport in the UK. Edwards comes from British Midland, where she was duty manager at Liverpool Airport and at Heathrow Terminal 1.

■ CATHAY PACIFIC

Andrew Hoad has been appointed general manager supplies at Cathay Pacific. He replaces **Albert Harrison**, who will be director of Belfast Airport in the UK.

■ TECH/OPS

Steven Koenig has been named senior vice-president for Tech/Ops International of San Mateo, California. He has been a vice-president with the company since 1993



Martin Tyler-Bennett

■ UNISYS

Unisys has appointed **Martin Tyler-Bennett**, a specialist consultant in customer relationship and loyalty marketing management for airlines and other transportation sectors. Before joining Unisys, Tyler-Bennett acted as consultant for Thai Airways and several other airline projects.

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BACK
FROM THE
BRINK



Is safety really paramount?

Sir — The way James Weber blows his country's own horn is in bad taste (*Flight International*, Letters, 8-14 February, P41). His arguments about safe air travel in the USA are invalid. Need we remind him about the way the McDonnell Douglas DC-10 was allowed to keep flying, despite accidents in the 1970s and 1980s? Why was the US Federal Aviation Administration not as stringent with the DC-10 as it was with the ATR turboprops?

I am not defending the French Directorate General of Civil Aviation. Rather, I am asking: are certification standards really what they should be?

Are certification authorities, on both sides of the Atlantic, doing their job, or are political pressures



Was the FAA more lenient with DC-10s than it has been with ATRs?

and national pride forcing them to turn a blind eye to aviation's first rule: honesty?

A PAPADAKIS
Macedonia, Greece

Peeking in the backyard

Sir — Before James Weber accuses the French Directorate General of Civil Aviation and

Airbus Industrie of "...letting aircraft continue to crash while they work out what is happening", he should look at his own "backyard". Despite growing evidence that the Boeing 737 rudder system may have contributed to a series of fatal accidents, the US Federal Aviation Administration is still trying to sort out the problem.

HALUK TAYSI
Weyhe, Germany

The dangers of an SRA approach

Sir — I know little of the Boeing 737 accident at Coventry Airport on 21 December, 1994, accident, but alarm bells rang in my mind when I read that a surveillance radar approach (SRA) was used.

At Hamburg in 1991, I flew such an approach in instrument meteorological conditions. It was a short-notice approach because of the disablement of a Boeing 727 on the instrument-landing system runway. Contrary to what I had expected, air traffic control (ATC) only advised of distance to go — and not the expected altitude at each mile to go. I had the appropriate Jepps SRA chart available, and so could study the required profile.

I had expected ATC advice such as, "four miles — you should be 1,200ft". Instead we were told: "Four miles — turn left 5°," and nothing about the altitude.

The approach seemed disjointed and uncomfortable because we did not know what increments would be used in the next call. This meant constant references to the distance/altitude scale on the chart by both pilots.

A problem with an SRA occurs if the aircraft goes high on profile. For example, a call of "...four miles to go, you should be at 1,200ft" is a fine, but suppose the aircraft is actually at 1,400ft. The natural tendency is to increase the rate of descent in an attempt to "catch up" by the time the next increment is called. On a ground-controlled approach, ATC would say, for example, "...slightly high on glide slope, increase your rate of descent". There is no such luxury on the SRA.

Add anxious piloting because of poor visibility, and the picture emerges of an aircraft high on slope, power reducing to minimise power build-up, and the inevitable increase in sink rate possibly going unnoticed.

Most medium/heavy airliners have maximum recommended sink rates of 1,000ft/min (5m/s) when below 1,000ft. Perhaps a cautionary call by ATC would be appropriate on all SRAs — eg, "caution — sink rate", which could be inserted at appropriate points down the approach profile.

JOHN LAMING
Tullamarine
Victoria
Australia

Effects of more productivity

Sir — Mr Holubowicz (*Flight International*, Letters, 25-31 January, P52) asks: why should increased productivity be detrimental to safety? I am a captain flying Boeing 737s, and I shall answer this question.

The cumulative effect of changing sleep patterns, altered rosters, 12-14h days, restricted or no summer leave can result in a pilot feeling disoriented and exhausted.

The same pilot probably has a mortgage to pay and a family to support. He needs his job. He is unlikely to declare himself "fatigued" on a regular basis. He therefore flies when he is not properly fit. It is human nature.

If more productivity means sensitive and efficient rostering, then pilots have little to complain about. If it means excessive night duties with minimum rest periods, as I suspect it does, then this extra productivity must indeed be detrimental to safety.

PAUL HEGAN
Hove, Sussex, UK.

WHAT'S ON

Flight International Aerospace Industry Awards: deadline for entries is 24 March, 1995. Contact: Lisa Devlin, *Flight International*, Quadrant House, Sutton, Surrey SM2 5AS, UK; tel: +44 (181) 652 3315; fax: +44 (181) 652 8981.

Russian Aerospace '95 — a Flight International conference in co-operation with Aviaexport, 25-27 April. Contact: First Europe Communications, 43-45 St John Street, London EC1M 4AN, UK; tel: +44 (171) 490 3318; fax: +44 (171) 490 3319.

RAeS Events — March (in London, unless otherwise stated): STRV 1A & B 1 March; **The role of GPS in European Civil Aviation,** 2 March; **Lindbergh Lecture** 7 March; **39th RJ Mitchell Lecture** 8 March, Southampton; **Rafale Lecture** 9 March; **40th Chadwick Lecture** 15 March, Manchester; **The Adaptation of the Helicopter to Special Roles** 16 March; **J D North Lecture** 16 March, Wolverhampton; **Sholto Douglas Lecture** 16 March, Heathrow; **The Role of Intelligent Systems in Defence** 27-28 March, Oxford; **High Lift and Separation Control** 29-31 March, Bath; **Oxford Air Transport Course** 19 March-1 April, Oxford. Contact: The Conference Office, Royal Aeronautical Society, 4 Hamilton Place, London W1V 0BQ, UK; tel: +44 (171) 499 3515; fax: +44 (171) 493 1438.

Cranfield Short Courses — March: **Airport Economics and Finance Symposium** 6-10 March; **Computer Modelling of Aerospace Vehicle Dynamics** 20-24 March; **Effective Marketing in Air Transport** 27-30 March, Cranfield, Bedford, UK. Contact: Lesley Roff, Short Course Manager, Cranfield University, Cranfield, Bedford MK43 0AL; tel: +44 (1234) 750111, ext 2564; fax: +44 (1234) 751206.

Avionics Workshop 11 March, San Antonio, Texas, USA. Contact: Rick Garcia, 4243 North Westshore Blvd, Tampa, Florida 33614, USA; tel: +1 (813) 879 9714; fax: +1 (813) 875 4514.

Open Cockpit Day 12 March, Weston-super-Mare, Avon, UK. Contact: Avia Press Associates, 75 Elm Tree Road, Locking, Weston-super-Mare, Avon, UK; tel: +44 (934) 822524/820711; fax: +44 (934) 822400.

Aero Engine Design 13 March, Filton, Bristol, Avon, UK. Contact: Justin Matthews, Hon Sec, Royal Aeronautical Society, Bristol Branch, c/o British Aerospace Airbus, C2-3460, B56 C2 Technical Centre, PO Box 77, Filton, Bristol, BS99 7AR, UK; tel: +44 (117) 9364006; fax: +44 (117) 9364270.

Lightning Protection of Avionics 13-17 March, Pittsfield, Massachusetts, USA. Contact: Lightning Technologies, 10 Downing Parkway, Pittsfield, Massachusetts 01201, USA; tel: +1 (413) 499 2135; fax: +1 (413) 499 2503.

The opinions on this page do not necessarily represent those of the editor. *Flight International* cannot undertake to publish letters without name and address and reserves the right to select or edit letters



Annual dinner of the British Air Charter Association, Londonderry House, 1949

YUCKSPEAK

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◆ BA chief Sir Colin Marshall, in his Sefton Brancker memorial lecture, tells the Chartered Institute of Transport that his airline does want the projected 600-seat New Large Aircraft, but that it also wants it to be "...major-maintenance-free for the first ten years, and corrosion-free for its entire life." Delford Smith's Evergreen International in Oregon has got something that needed no major maintenance in its first ten years, and has

ROGER'S TOTAL AVIATION BOOKSHELF

Warplanes of the Luftwaffe,

Edited by David Donald, published by Aerospace Publishing, 3A Brackenbury Rd, Hammersmith, London W6 0WE.

Positives: lists all the really odd machines that the German industry produced in the 1939-45 period, as well as the well-known ones; nice artwork; fascinating photos of things you never even knew existed.

Negatives: sometimes chaotic layout (especially in the technical descriptions surrounding the major artworks), irritatingly bad grammar ("The Do 24T2, introduced in 1943, replaced the French 20mm cannon with a German MG 151..."), looks like a revamp of earlier published work.

TAB Rating:

- ☐ Top shelf
- ☒ Middle shelf
- ☐ Bottom shelf
- ☐ Wheel chock

remained corrosion-free ever since: it's called the

Hughes HK-1 Hercules, or *Spruce Goose* to the rest of you...

◆ ATCOs in Ulyanovsk are taking industrial action, but because they could be fired for refusing to work, the controllers have gone on hunger strike. This would normally mean that they would have to be sent home. However, the people who have to decide on their fitness or otherwise are state-employed doctors who have refused to declare them unfit for work. At least one striker has already fainted at his radar scope, and others are expected to follow. Is this what is meant by a collapse of service?

John P. ...



Giving evidence to the enquiry, Sir Archibald Apron of British Aviation Arcades said: "As you can see, the limitation at our airport is terminal capacity. We're already overcrowded, and it's still only spring. Also, some passengers are bringing bags with them, too: we suspect that some of those bags have lunches in them, and that will cost us a lot of sales. We must be allowed to build another restaurant." A spokesman for Birdseed Airlines said: "It's a myth that we need more runways: look at all that grass, and hardly an aeroplane in sight. Where's the beer tent?"

(Competition day, Cowes Airport, Isle of Wight, 1949)



75 YEARS AGO

Extracts from *Flight*, March 4, 1920

A New Avro Triplane

Special interest attaches to the latest production of the Avro Co, which has just successfully gone through its trials at Hamble, inasmuch as it revives the early activities of this pioneer firm, when Mr A V Roe produced — if not originated — the tractor triplane type of machine...



In the Avro Type 547 Triplane with Beardmore engine, the pilot is located well back along the fuselage, at the rear of the cabin, with his head projecting above the top of the fuselage. From here he has an excellent view in all directions...

The Flight to The Cape

Of the four machines which were flying on the Cairo-Cape route last week, disaster overtook three, and, at the time of writing (Wednesday), the Silver Queen II, the South African Government's Vickers-Vimy, is the only one left in the running.

Flying and Curious Phenomena (continued)

Referring to the letter of Willy Coppens last week, I may say that I have already observed the same phenomenon... When the sun is rather high above the horizon, the rainbows produced by reflection of the sun rays may figure complete circles. Sometimes it happens that the upper portion of these circles is absent, so that one sees a reversed rainbow.

Vie de Marolles, late Flying-Liuet, AMF

International Air Mail Services

It is to be hoped that the "allégement" is true that officers of the Civil Aviation Department of the Air Ministry and Post Office experts are in consultation on the question of the inauguration of new international air mail services, and there is likely to be a considerable extension of the present facilities shortly, and a reduction in the scale of charges. And about time, too!

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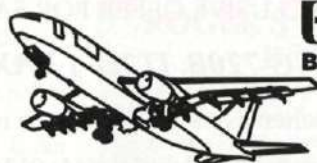
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The consultancies specialise in certain fields eg:

Aircrew: Captains, First Officer, Pilots etc.
Cabin Crew: Stewards, Stewardesses etc.
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AWARDS '95**

The search is on to find winners within the world aerospace and airline industry. Should your company be among them? Flight International and its supporting sponsors have now launched the Aerospace Industry Awards '95. The aim of these unique awards is to recognise those companies that have achieved excellence over the last year in each of the following categories.

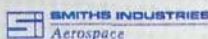
Categories

- Air Transport
- Business & General Aviation
- Corporate Strategy
- Environment
- Helicopters
- Infrastructure
- Maintenance
- Military Aviation
- Space & Missiles
- Systems & Components
- Training & Safety

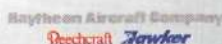
A special award for Aerospace Personality of the year, will also be presented to the individual who has made the greatest personal contribution to the industry.

The awards are to be judged by an independent panel of industry experts. And the winners will be revealed during the Paris airshow, at a gala banquet, in the Meridien hotel, Montparnasse, on the 12th of June.

To ensure that your achievements are fully recognised by the aerospace community, make sure that your company submits an entry. To obtain your official entry form simply complete and fax back the coupon below.



NORTHROP GRUMMAN



Please send me an entry form: [Please write clearly in BLOCK CAPITALS]

Name Address

Job Title

Company Tel Fax

PLEASE RETURN, BY FAX +44 (181) 652 8981

or BY POST to, Flight International, Quadrant House, The Quadrant, Sutton, Surrey, SM2 5AS, UK.