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is also responsible for the UK-only air-defence ADV Tornado.

About one-third of the German share of the programme cost of DM15,000 million (1976) (about £3,300 million [1976]) has now been spent, and Germany is having to achieve maximum output per man-hour to absorb the 20 to 30 per cent rise in the value of its contribution caused by the rise in the relative value of the DMark. Peak em-ployment on Tornado in all three countries of 70,000 will be reached in about two years. The German manpower should not rise above 28,000 or 30,000.

Tornado costs in 1976 DMarks are reported as follows: flyaway cost, including airframe, engines, avionics and general equipment, DM27-98 million (about £7-56 mil-lion); German unit cost, including flyaway cost plus 11 per cent VAT, customs charges and DM2-84 million-worth of long-lead items for production, DM34-07 million (about £9-38 million); system cost, including the above plus basic spares, ground equipment, test equipment, training equip-ment, documentation, technical modifications, armament and inter-country transportation, DM51-11 million (about £13-8 million).
In the competition for the Canadian new fighter aircraft (NFA), Panavia is leading the Tornado submission. Canada wants about 120 aircraft for air-to-ground attack with Nato in Europe, air sovereignty over northern Canada and for operation with Norad. Much will depend on the degree and type of offset offered, and German manufacturers have worked out a broad selection of offers. Besides receiving a straight share in Tornado production, particularly of the engines, Canada might join Panavia and Namma. Non-Tornado aerospace offsets could include Panavia market-ing of the Dash 7 in Europe and its use by the German Air Force. European military pilots might be trained in Canada. Joint defence programmes could be arranged at government level. Many Tornado suppliers could start joint non-aviation industrial ventures with Canadian com-panies and import Canadian products.

Panavia is also offering Canada an air-defence version of the basic IDS Tornado, less costly and available sooner than the ADV itself. The Texas Instruments nose radar could be modified with additional digital capacity to pro-vide Doppler beam sharpening for air-to-air operation. Panavia is keeping in close touch with the development of the Australian new fighter requirement, and Australian teams visiting Europe next month will almost certainly call on Panavia.

Alpha Jet Production in Germany, France and Belgium is now really under way: Dassault-Breguet makes the centre and forward fuselage, while Dornier contributes the wing, empennage, rear fuselage and intakes. Cur-rent orders cover 84 attack/reconnaissance versions for Germany and 56 trainers for France, plus 33 Mk IB trainers for Belgium. The French El trainer production aircraft has flown and the German Al attack aircraft should have flown by now. A2 is due to fly in May and A3 in July. The first Belgian machine flies in June, and production rate should reach six Germans, four French and two Belgians a month during 1979. By the end of 1980, production rate will be at its peak of 15 a month and 219 aircraft will have been delivered. All 400 Franco-German Alpha Jets will have been completed by the end of 1981. Exports to third-world countries have been launched with orders for Ivory Coast (6 + 6), Togo (5) and Morocco (25). Egypt might licence-build the aircraft.
The first German Alpha Jet unit will form in 1979 as Weapon Training School No 50 (Waffenschule), later to be renamed the 49th Fighter Bomber Wing (JaBo 49). The 49th will train F-4EF combat observers as well as Alpha Jet crews. Later in 1979, the weapon school in Sardinia will convert from G.91 to Alpha Jet, and all G.91s will be phased out by the end of 1981. JaBo 43 at Oldenburg will convert in 1980 and JaBo 41 at Husum in 1981. The German Air Force is setting up an Alpha Jet support depot at LeipHeim. Dornier manages the logis-tics.

German Alpha Jets will have a German Lear Siegler gyro platform and Litef Doppler with Teledyne/Litef navi-

Dornier has launched production of the rear fuselage, wings and tai
of the Dassault-Breguet-Dornier Alpha Jet

gation computer, TRT radio altimeter, SEL Mitac/Setac DME, Siemens IFF/SIF, Rohde u Schwartz com radio and Becker intercom. The Kaiser/VDO HUD is a flight direc-tor and air-to-air sight as well as weapon-delivery sight. The stores carried on four underwing pylons will be sup-plemented by a 27mm Mauser gun in a centreline pod. Alpha Jet may be adapted to carry Maverick or Hellfire missiles.

Dornier has invested DM30 million (about £8-1 million)
in multi-head, numerically controlled milling machines and etching tanks to cope with the high proportion of machined skins and chemical milling in the Alpha Jet. All produc-tion airbrakes are carbon fibre, but an empennage and wing of carbon fibre will be tested soon. The empennage may be adopted for production.

TKF Taktisches Kampf Flugzeug MBB, VFW-Fokker and Dornier have all been studying future German combat aircraft (TKF) for a number of years, and many elements of the KEL and ZTL research programmes (which see) are aimed at preparing structures, aerodynamics and con-trols for TKF.

Although there is now strong pressure to combine the German TKF with the British AST.403, and possibly with a French requirement, the German need is largely for an air-combat aircraft to intercept enemy intruders at low or extremely low levels. The h'"gh-aititude threat i= covered by USAF F-15s and SAMs. German designers Feel increas-ingly that the 1KF mission is incompatible witn the bntish need for a Harrier/Jaguar replacement.
A German Air Force specification may be issued later this year for a proposed in-service date beyond 1990. TKF will be a twin, because this reduces peacetime operating cost and because two R-R RB.199s currently offer the right power:weight ratio for the expected gross weight of around 30,0001b. Nothing is being done to exclude Vtol capability, but Germany would be content with a 1,500ft ground roll. Even an advanced Harrier, say German de-signers, will not derive enough acceleration from the 15 per cent thrust increase of plenum chamber burning to give air-combat performance.
The potential enemy is the fighter coming in at low level carrying bombs or missiles. If interception forces it to drop its weapons, the defence is successful, but the intruder then has fighter performance, and the defender must be capable of dogfight'ng. TKF must turn tightly to intercept, but may also need the agility to fight, even with cannon.

Studies of straight versus delta wings showed that a combination of delta with vortex-inducing strake, tail-plane and automatic slats and flaps gave the best of both