Attacking Targets Beyond the FEBA

NATO needs new weapons

by Mark Hewish

A major problem facing NATO is its inability to match the Warsaw Pact's relentless build-up of conventional weapons for use in a European war. The Alliance's present conventional force structure in Europe has changed little since the 1950s and 1960s. In that era, when the doctrine of massive retaliation reigned supreme, NATO's conventional forces provided the tripwire for a nuclear response. The Soviet Union reacted by building up a large theatre nuclear capability, and in 1967 the West switched to a doctrine of flexible response, with the emphasis on battlefield nuclear forces. The United States' main gift to Europe — the strategic nuclear umbrella that allowed European countries to keep their defense budgets low and concentrate on rebuilding their economies — remained in force.

Throughout the 1970s and into the 1980s, however, the Warsaw Pact steadily upgraded its theatre nuclear forces in terms of both numbers and capability. As the West's tactical nuclear advantage was being reduced, NATO also failed to close the traditional gap between the size of its conventional forces and those available to the Soviet bloc. Simultaneously, the West's technological superiority was being eroded. The Warsaw Pact has maintained its post-World War 2 level of 180 divisions facing NATO, and now also has 4,000 aircraft and 12,000 nuclear weapons available for European operations. The Western Alliance can field only 26 divisions, plus five in reserve, with 2,000 aircraft and 6,000 nuclear weapons.

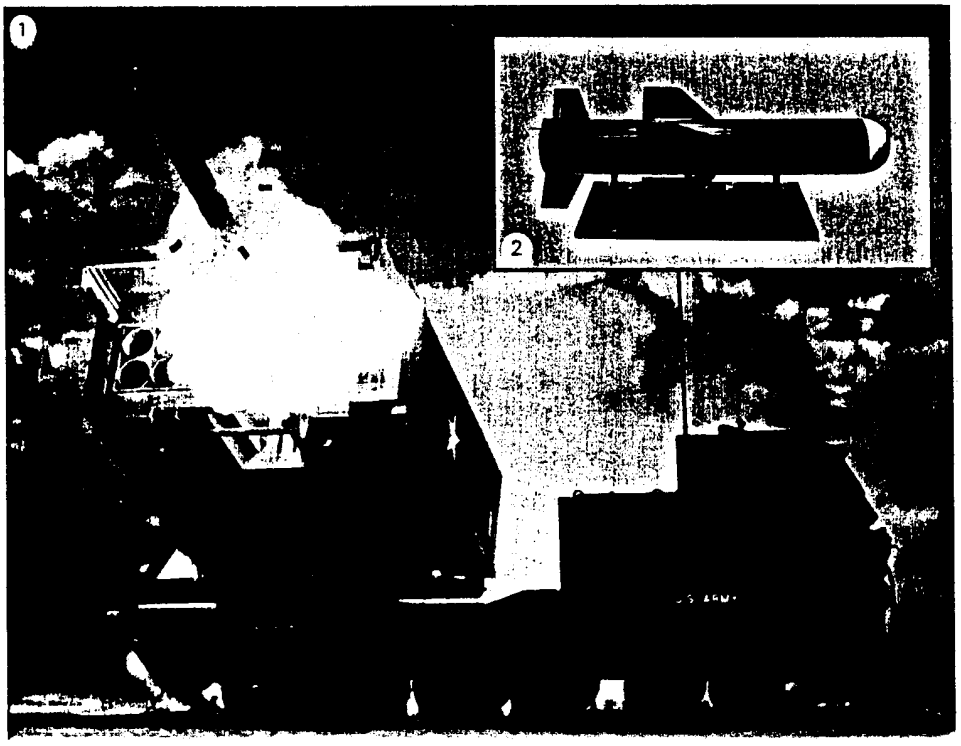
NATO studies show that, at the outbreak of a war in Europe, the Alliance would have only 400 to 600 aircraft available for interdiction missions. These would be required to attack some 2,000 fixed targets from the FEBA out to a depth of 300km, together with large numbers of vehicles in each Warsaw Pact armoured division. Analyses have shown that current aircraft armed with free-fall 227kg bombs would have to fly 2,200 sorties to destroy 60 percent of the assets of a single armoured division.

At present, therefore, NATO could not interdict the second echelon forces of a Soviet attack by means of conventional weapons alone. The problem is compounded by the Warsaw Pact's heavy emphasis on chemical weapons, for which the West has no equivalent deterrent. The need to wear NBC protective clothing continuously degrades a soldier's ability to fight effectively by up to 80 percent. Therefore, in the opinion of several senior US defense officials, NATO would be lucky to last a week without having to escalate to a nuclear exchange as its last chance of stemming the tide.

General Bernard Rogers, Supreme Allied Commander Europe, has been saying for four years that NATO needs to build up its conventional forces to a point where they act as a deterrent in their own right. NATO's conference of National Armaments Directors (CNAD) has drawn up a list of four areas to be emphasised:

(1) stopping the first-echelon attack with the aid of indirect-fire weapons such as MLRS Phase III and smart artillery munitions, using remotely piloted vehicles for reconnaissance and targeting;
(2) attacking follow-on forces from stand-off ranges;
(3) using specialised airfield-attack weapons for both offensive and defensive counter-air operations;
(4) improving the type and survivability of battlefield information by so-called tactical fusion systems and interconnected C^3I networks.

The West cannot match the Soviet Union one-for-one, because of political and economic limitations, so it must emphasise its technological superiority. The United States now spends about $8,000 million a year on nuclear weapons, of which about half is allocated to tactical weapons. Many senior US planners believe that an expenditure of between $2,000 million and $4,000 million a year on conventional weapons for what is generally known as deep attack — interdicting follow-on forces — would make a significant contribution to NATO's ability to win a European



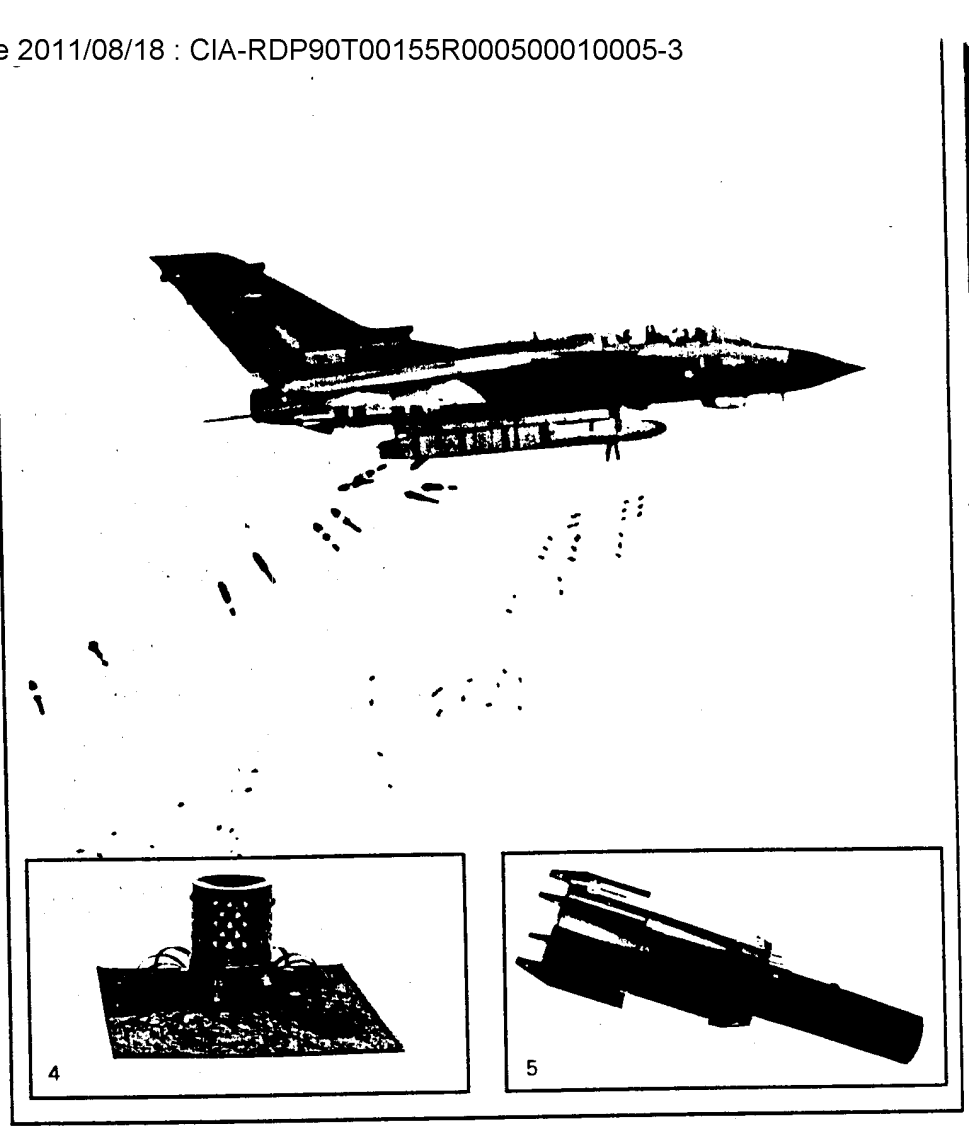
1,2 — A major increase in NATO firepower against enemy first echelon forces will be provided by the LTV Multiple Launch Rocket System (MLRS — **1**), which has a range of up to 40km depending on the type of warhead. The first battery is already deployed with the US Army and MLRS is also planned to enter service with the armies of France, Germany, Italy and the UK. The MLRS Phase III development, dispensing six Terminally Guided Warheads (TGW) based on a millimetre-wave homing design proposed by Raytheon (**2**), is not scheduled for service entry until 1992, under present plans. Because of the realignment of the Joint Tactical Missile System (JTACMS) program, the US Army's next-generation system for attack of enemy forces at ranges out to 70km — which is likely to be a derivative of MLRS — may be well into development, if not production, by then. The Phase III TGW is likely to be used in this and other dispenser systems.

war. To put this in perspective, $3,000 million a year would not even buy a single additional division of the type now fielded in Europe.

In 1981 the US Defense Science Board highlighted 17 areas of technology that could make a significant contribution to redressing the balance. Of these, nine apply to the concept of deep attack:

- very high-speed integrated circuits (VHSIC)
- stealth developments
- advanced software and algorithms
- fail-safe/fail-tolerant electronics
- machine intelligence
- microprocessor-based personal learning aids
- supercomputers
- materials such as advanced composites
- high-density focal-plane arrays.

These "emerging technologies" (ET) will allow NATO to extend its conventional stand-off capabilities. Present technology permits the acquisition and attack of soft area targets at ranges of 100-150km. In the near term, this will be extended to encompass hard area targets at the same ranges. Research is now aimed at establishing the ability, in the long term, to attack hard point targets at ranges greater than 100km. In April 1984, CNAD agreed to consider 11 programs as part of ET, including several relating to deep attack, such as the terminally guided warhead for MLRS Phase III, JSTARS, and some elements of management-information systems.



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3, 4, 5 — The British Royal Air Force will soon begin receiving the JP233 airfield attack weapon from Hunting Engineering, to equip its *Tornado* IDS aircraft (**3**). The *Tornado* will have to overfly its targets in order for the JP233 to dispense its HB876 (area denial — **4**) and SG 357 (cratering — **5**) submunitions. Hostile air defenses are likely to become increasingly dense and effective, and the RAF is now funding teams led by Hunting and British Aerospace to design a powered stand-off dispenser that will allow *Tornados* tasked with counter-air missions a greater chance of survival.

Stopping the first echelon

Five NATO countries — the United States, Germany, France, Britain and Italy — are increasing their artillery inventories in the short term by deploying the LTV Aerospace and Defense MLRS (Multiple Launch Rocket System, *IDR* 5/1980 pp. 728-732). The US Army fielded the first operational MLRS battery of nine launchers in early 1983 and plans to spend a total of some $4,000 million on more than 300 launch vehicles and approximately 400,000 rockets. The four European countries have set up the European Production Group (EPG), comprising RTG (Raketen Technik Gesellschaft — owned jointly by MBB and Diehl) in Germany, Hunting Engineering in Britain, Aérospatiale in France and Bombrini Parodi Delfino (BPD) in Italy. Britain is waiting for a European production line to be set up before ordering a planned 105 launchers and 82,500 Phase I bomblet-dispensing rockets (plus 12,500 training rounds) from the consortium; Germany would take 200 launchers, 16,000 training rounds, 65,000 Phase I rockets and 20,000 Phase II anti-tank mine dispensing rockets; France would require 55 launchers, 3,000 training rounds and 32,000 Phase I rockets; while Italy wanted 20 launchers, 1,420 training rounds, 5,400 Phase I rockets and 600 Phase II rockets.

According to LTV, a single MLRS vehicle with its three-man crew and carrying 12 rounds represents more firepower than 18 203mm howitzers manned by nearly 600 personnel. The launcher vehicle's inertial-navigation system is accurate to within 0.4 percent of the distance travelled and is normally updated every two hours or so. Less than two minutes elapse from the vehicle stopping to the launcher being laid on the first target, and the interval between successive rounds can be as little as four seconds: two seconds to re-aim, and a further two seconds to allow turbulence from the previous round to subside. Even the first rocket is claimed to be more accurate than a howitzer after firing many registration rounds.

The MLRS Phase I round accommodates 644 M77 bomblets, an improved version (with a slightly longer ribbon parachute) of the M42 that is carried in the cargo rounds fired from the 155mm M109 (88 bomblets) and 203mm M110 (190 bomblets) howitzers. The M77, which weighs some 180g, carries a shaped charge that will penetrate up to 100mm of armour. The MLRS Phase I round dispenses its M77s at a density of some 250/hectare (compared with about 200/hectare for the M109 and M110), equating to a separation of about seven metres between the bomblets and a coverage pattern measuring 80-100m in diameter at maximum range. The Phase II rocket houses 28 RTG AT2 mines and is approximately 45kg lighter than the Phase I round, increasing maximum range from more than 30km to some 40km.

The US, France, Britain and Germany also plan to buy the Phase III version of MLRS, carrying terminally guided submunitions to attack moving targets. Multi-national industrial consortia are now conducting a 28-month competitive component-validation phase for the terminally guided warhead (TGW).

which is expected to be followed before the end of 1984 (possibly in September) by the selection of one or more teams to proceed with the planned 30-month system-validation phase. At one time the program was due to be narrowed down to one team at this stage, but *IDR* understands that two consortia are now likely to receive further contracts. Managerial as well as technical problems still remain: the United States would prefer competition at all stages, whereas the European partners want their nominated contractors to remain in the running. This could lead to further reshuffling of team membership for the next phase. Another problem is the long timescale — a further 40-month maturation and low-rate production phase, currently planned to follow system validation, would stretch the program to 98 months and prevent service entry before 1992.

The technical solution adopted for the TGW is the "long-glide" concept originally proposed by the team led by Raytheon. The MLRS Phase III would contain six unpowered TGWs, or submunitions, in the nose of the rocket. These would be expelled to form a ring, with the individual submunitions entering a shallow dive and individually homing on to their targets by means of millimetre-wave radar seekers. *IDR* understands that targets would be acquired initially by the 94GHz seeker operating in active mode, which would then switch over to passive radiometric homing at a range of some 250m in order to minimise glint problems. A steep dive during the final stages of an attack allows the submunition's warhead to penetrate a tank's lightly armoured upper surfaces.

The United States is expected to bear 40 percent of the cost of the TGW program, with the three European countries contributing 20 percent each. The submunitions developed for MLRS Phase III are also likely to be adopted for other dispensing weapons.

Despite its recent problems, the Martin Marietta *Copperhead* laser-homing 155mm shell will make a significant contribution to the West's armoury. The weapon's reliability in lot-acceptance tests has now reached 83 percent, and the company is building 15 to 17 rounds a day. Total procurement is planned to reach 44,000 by 1991 for the US Rapid Deployment Forces, and further sales in Europe are likely.

The US Army's plans to deploy the SADARM (Sense and Destroy Armour, *IDR* 8/1980, pp.1235, 1236) munition ran into problems during the Spring of 1984, when Congress cut off funds as a result of the Army's inability to agree a unified plan for anti-armour munitions. The program is expected to be relaunched in October, however, initially to provide a "smart" round for the 203mm howitzer. Some 2,000 to 3,000 of these heavy calibre artillery pieces remain in the US inventory for the nuclear and counter-battery roles. Weapons of 155mm calibre are operated much more widely, however, and one candidate to provide a fire-and-forget anti-armour round in this category is the Avco Systems XM898 (formerly known as the Enhanced Sensing Munition). This packs four *Skeet* submunitions into a standard M483A1 cargo shell. The *Skeets* are ejected over the target and deploy a simple Kevlar wing with a tip weight. This causes the descending submunition to describe a rotational motion similar to that of a single sycamore seed, so that the *Skeet*'s infra-red seeker scans over a large area to find the target. A millimetre-wave radar altimeter detonates the submunition at the correct height, firing a self-forging fragment through the top of the tank. Those submunitions that fail to find a suitable target while descending have a secondary role as run-over mines.

Follow-On Forces Attack

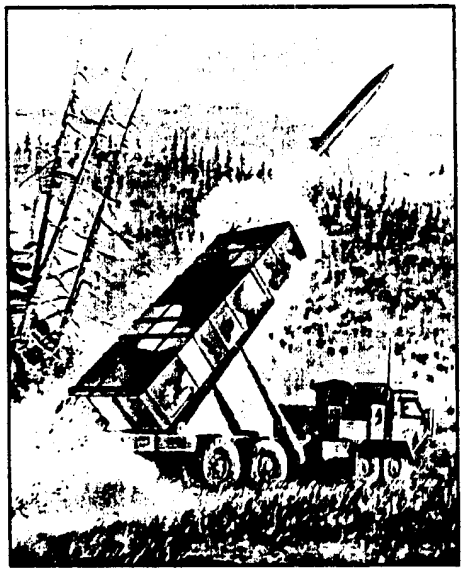
NATO is now establishing its long-term policy guidelines for Follow-On Forces Attack (FOFA), which it defines as engaging targets at ranges from 25km to more than 400km beyond the FEBA. Mission-need documents drawn up by SHAPE are expected to be submitted to the CNAD before the end of 1984. This wide range bracket overlaps with weapons such as MLRS and cannon artillery, and air-launched weapons are in many cases suitable for both close support and interdiction.

● **Long-Range Stand-Off Missile**. NATO expects three memoranda of understanding relating to new air-to-surface weapons to be signed this year. The first, covering competitive feasibility studies of the Long-Range Stand-Off Missile (LRSOM) to enter service in the early 1990s, was due to be signed this summer. The 18-month studies, costing $6 million (provided equally by the United States, Germany and Britain), are expected to be conducted by two teams: one led by Boeing and including MBB, British Aerospace Dynamics and Marconi Avionics; and the other headed by General Dynamics' Convair Division and involving Dornier and Hunting Engineering. Major sub-

Improved Lance proposals

Although the USAF now plans to use a cruise missile for the deep attack role, rather than a weapon based on either *Lance* (T-22) or *Patriot* (T-16), the problem remains of how to replace *Lance* itself. LTV Aerospace has proposed an improved version of the weapon to replace the 16 *Lance* battalions deployed by NATO in Europe. *Improved Lance* would have a solid rocket motor, using the same propellant as in MLRS, in place of the present liquid motor. This provides three times the 110km range of the present missile, allowing the weapon to be launched from 50km west of the present FEBA yet still reach the East German/Polish border as well as providing cross-corps support. The improved missile would have five times the accuracy of its predecessor (0.5mrad rather than 2.5mrad, equating to a 50m CEP at a range of 100km) and three times the lethality, using the M251 warhead carrying 825 M74 anti-personnel/anti-materiel bomblets dispensed over an area 400m across.

LTV Aerospace has offered the US Army a firm, fixed-price contract for *Improved Lance*, and estimates that RDT&E and production of an initial 1,000 missiles would cost less than $600 million (at 1983 prices). The missile itself, at some $175,000 a round, is half the price of existing *Lance*. A further $75,000 buys the APAM warhead, while conversion of existing launchers (including the addition of a fire-control system derived from that in MLRS, and a vehicle navigation system) would cost $800,000 per launcher. Phase 1 of *Improved Lance*, using converted single-round launchers, could enter service in 1987-88. Phase 2 would introduce new three-round launchers on wheeled chassis, while Phase 3 would add further warheads: a terminally guided version for attacking hard structures, an improved nuclear payload, a chemical warhead and anti-armour submunitions.

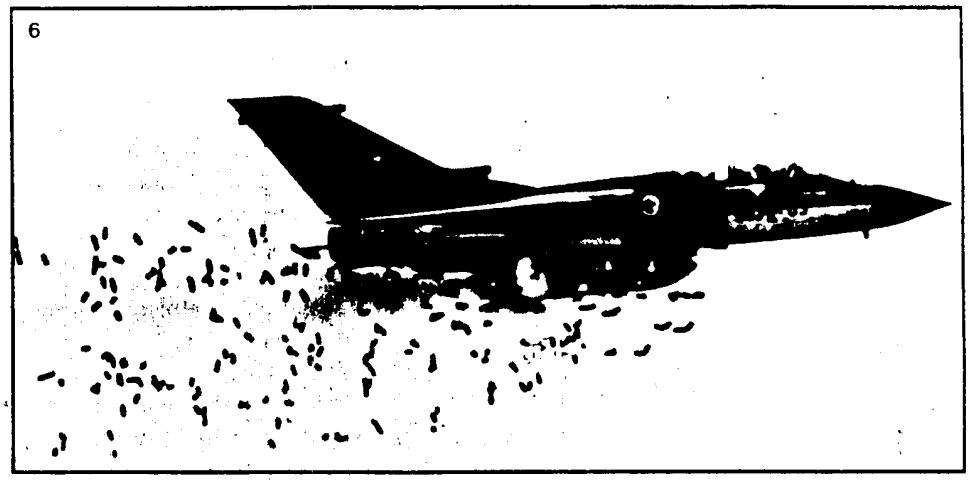


LTV Aerospace has signed marketing agreements for *Improved Lance* with the Royal Ordnance Factories in Britain, Wegmann in Germany and Difesa e Spazio in Italy. The European contractors would be offered co-production, and co-development if possible. They would also be able to contribute to the development of new warheads and ground support equipment.

contractors on the GD-led team are expected to include AEG-Telefunken, LITEF, Thorn-EMI, Lucas Aerospace and Marconi Defence Systems. The US Air Force will act as lead service for the feasibility studies.

LRSOM would be a subsonic cruise missile with a range of 500-600km and carrying various specialised payloads to attack targets such as air bases, bridges and C³I bunkers. As the total payload will be limited to 500-600kg, the missile itself will be required to incorporate extremely accurate mid-course and terminal guidance so that small targets such as hardened aircraft shelters can be destroyed at long ranges with "dumb" munitions.

The Boeing-led team will draw on the US company's experience with the Air-Launched Cruise Missile (ALCM) program and on the work that has been under way at British Aerospace Dynamics for several years on a cruise-missile derivative of *Sea Eagle*, known as P4T, with TERPROM guidance. General Dynamics Convair also has extensive cruise-missile expertise from the *Tomahawk* and derivative Medium-Range Air-to-Surface Missile (MRASM) programs. Dornier is contributing its knowledge of subsonic unpiloted vehicles from the CL-89/CL-289 drone projects and Hunting Engineering is offering its work on submunitions with the JP233 airfield-attack weapon system. Dornier has been collaborating with GD since 1978 on studies applica-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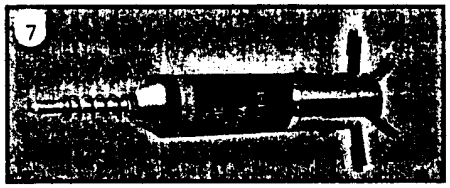
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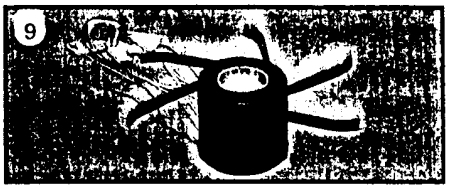
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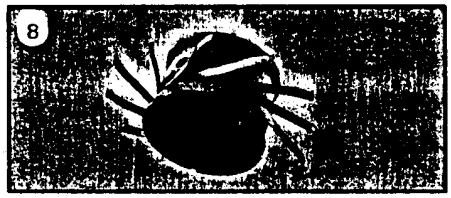
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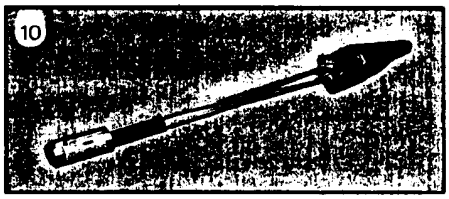
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6-10 — RTG (owned by MBB and Diehl) is to deliver the first production MW-1 dispensers in October, to equip Luftwaffe *Tornados* (**6**). The Italian Air Force also wants the MW-1. The weapon can dispense either anti-tank or anti-airbase submunitions. Anti-tank submunitions include the KB 44 (**7**) and MIFF (**8**) plus the MUSA mine (not shown), while those for use against airbases include the MUSPA (**9**) and STABO (**10**). See text for further details. These submunitions are also being proposed for a variety of US and Franco-German powered, stand-off dispensers.

ble to LRSOM, emphasising guidance and warhead options. The German company has also developed "stealth" techniques as part of its future fighter studies. Dornier prefers a dispenser arrangement that can accommodate a wide variety of submunitions, with the emphasis on high reliability and low cost. The company has designed a dispensing mechanism whereby submunitions are ejected sideways from the weapon in pairs, then separated by a pyrotechnically-initiated air bag that accelerates the outer submunition laterally and retards the inner one. This allows the missile to attack targets immediately beneath it. Ejection speeds of up to 70m/s have been demonstrated, and components suitable for LRSOM will be test-flown at Eglin AFB in early 1985 as part of a US-German-British technology program. Dornier's studies have also concentrated on guidance techniques suitable for use in all weathers, including heavy snow on the ground. The company's original work on two-dimensional pattern recognition proved inadequate in snow, so Dornier has now added a range input — provided by a laser rangefinder or millimetre-wave radar — to build up a three-dimensional picture of the target.

The United States has recently re-aligned its efforts to develop a deep-attack weapon, which is now orientated around a cruise missile rather than a ballistic weapon (see below). Although the cruise solution adopted for LRSOM has advantages in terms of range and payload, making it suitable for attacking fixed targets such as airfields and bridges, it is slow and comparatively expensive. For this reason there has been a powerful US lobby in favour of a ballistic deep-attack missile that could engage moving targets at stand-off ranges by virtue of its quick reaction time. One argument in favour of this solution is that a mix of aerodynamic and ballistic weapons already exists in the forms of MX *Peacekeeper*/ALCM and *Pershing* II/GLCM, exploiting the individual advantages of each type.

The Europeans, however, have been less keen on ballistic weapons. A ballistic deep-attack missile could easily be mistaken for a nuclear weapon by the defending forces, and problems of demonstrating that such a weapon has no strategic role — especially if it is fired from a silo — appear to be insurmountable.

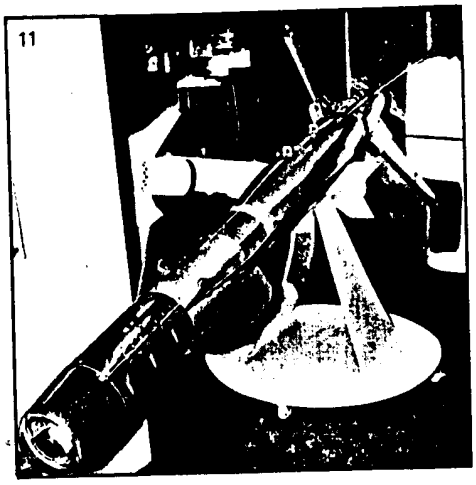
Until May 1984, the US Army and USAF were collaborating on their own joint weapon system for the deep-attack role: the JTACMS (Joint Tactical Missile System), with the Army as lead service, and the complementary USAF-led JSTARS (Joint Surveillance And Target Attack Radar System). On May 22, however, the two services revealed that they had reached agreement on which would be responsible for specific roles and missions. The USAF assumes responsibility for what was JTACMS and plans to develop a cruise (rather than ballistic) missile for this role. The weapon will have a range of 370-550km but will not be a derivative of the *Tomahawk* cruise missile or the previously cancelled MRASM. The Army will concentrate its efforts on a ground-launched weapon with a range of some 70km, possibly a derivative of MLRS (see above). Defense Department officials acknowledge that European concern about ballistic weapons was one reason for the re-alignment of the program, although the driving factor was cost.

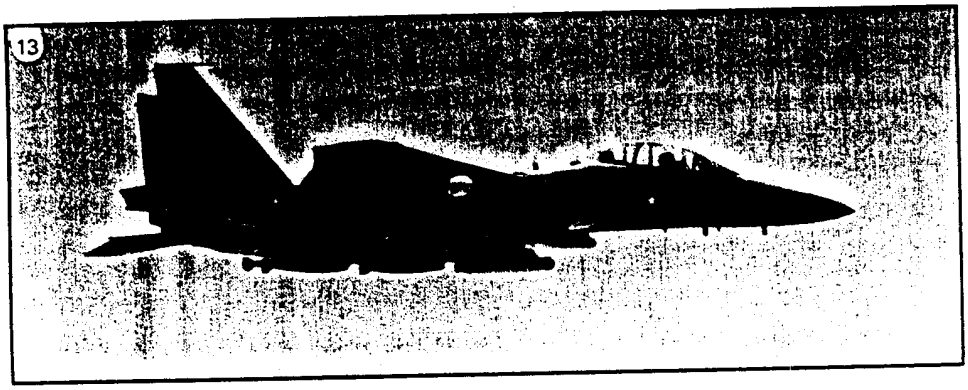
The JTACMS program had been launched by the Defense Department in

11 — The USAF has approved low-rate initial production of Texas Instruments' new *Paveway* III laser-guided bomb in its GBU-24 version (based on a Mk84 900kg bomb). *Paveway* III can be delivered from very low level, in all weathers, and can also be tossed from stand-off ranges.

12 — The Rockwell International GBU-15 TV-guided glide bomb, shown here on the port inboard pylon of an F-4E *Phantom*, has been adopted by the USAF as its interim stand-off weapon. Operational testing of an imaging IR version is due for completion by end-1984, and the USAF plans to develop an AGM-130 powered version, with a range of 24km.

13 — The McDonnell Douglas F-15E *Strike Eagle* has been chosen as the USAF's new Dual-Role Fighter. It features improved ground attack capabilities, including use of the twin-pod Martin Marietta LANTIRN system (shown in this impression), for laser illumination of targets at night. Other weapons will include the new Combined Effects Munition (CEM) cluster bomb, 19 of which can be carried. The CEM consists of an SUU-65/B Tactical Munitions Dispenser (TMD) loaded with 202 multi-role bomblets.





June 1982, six months before completion of the *Assault Breaker* project (*IDR* 9/1982, pp.1207-1211) that demonstrated the delivery of smart submunitions from ballistic carrier missiles. The two services had great difficulty in agreeing a common requirement: the Army wanted a ballistic weapon with a longer range than present artillery and rockets (out to about 100km beyond the FEBA), while the USAF leaned towards a cruise missile with a greater range. The targets to be engaged were similar, but with different emphasis on each one: the Army's list of priorities was C^3I targets, air-defense assets and manoeuvre forces, while the Air Force's main priority was Suppression of Enemy Air Defenses (SEAD), followed by anti-armour and counter-C^3I. The Army wanted anti-armour, Anti-Personnel/Anti-Materiel (APAM), mine-carrying and chemical warheads, while the Air Force favoured unitary (of approximately 500kg), anti-armour, APAM and possibly mine payloads.

Before the JTACMS program was realigned, plans called for a joint requirement to be agreed in May 1984. This was to have been followed by requests for proposals, evaluation of the bids and letting of a contract for full-scale engineering development, with service entry five to seven years later. Projected costs for research and development were $115 million in 1985 and $1,237 million over the period 1985-89. Details of the new program may not become clear for some time.

The complementary JSTARS radar system will now be installed only in the USAF C-18 (Boeing 707), and not in the TR-1 or Army OV-1D as previously planned. JSTARS, initiated in May 1982, absorbed the Air Force's *Pave Mover* and the Army's SOTAS BDS (Battlefield Data System) programs. It was intended as a complete management system to detect and track follow-on forces, and to guide attacks accurately against them. The airborne radar would initially operate in the wide-area MTI role to provide an "electronic high ground", with fixed-target indication and weapon-guidance modes being added later. Time-sharing would permit the simultaneous engagement of several targets. The C-18 would carry a large amount of on-board processing equipment and would have eight to ten operators/controllers in the fuselage, in the same manner as the E-3A AWACS. Information would be exchanged with ground stations and with other airborne platforms (including missiles being guided to their targets) over secure digital data links.

Concept-definition studies of the radar have been carried out by Hughes Aircraft, Westinghouse, General Electric and a team of Grumman and Norden. Before the program was re-aligned, plans called for selection of a single integrating contractor in August 1984, with full-scale engineering development lasting a further four years. Projected R&D spending was $203 million in 1985 and $666 million in 1985-89.

Over the next few years, NATO air forces will deploy a number of new weapons suitable for use against interdiction targets. RTG is due to begin production deliveries in October this year of the MW-1 (Mehrzweckwaffe 1) dispenser that will form the standard armament of Luftwaffe *Tornados*. MW-1, which weighs 4,500-4,700kg when loaded, contains 112 tubes that house submunitions of 132mm diameter. These submunitions are divided into two groups: HZG 1 (Hauptzielgruppe I), now in production, is optimised for the anti-armour role and comprises the KB44 bomblet, the MIFF (Mine Flach-Flach) anti-tank mine and the MUSA (Multisplitter-Wirkkörper, Aktiv) fragmentation mine. MW-1 can also carry the HZG II combination of submunitions in the airfield-attack role (see below). The same submunitions are planned to be used in the CWS/*Apache* free-flying dispenser, and MBB is offering a cut-down version of MW-1, known as MDS (Modular Dispensing System), for fighter ground-attack aircraft.

The US Air Force plans to deploy 60,000 rounds of the Hughes AGM-65D Imaging Infra-Red *Maverick* air-to-surface missile (*IDR* 5/1984, p.647), for which Raytheon has been named as second source. Joint production will rise to a peak of 44 rounds a month in 1986. The AGM-65D will arm the F-111, F-16, A-7, A-10 and probably the F-15E, allowing them to attack hard targets from stand-off ranges at night and through battlefield mist, smoke or haze. The F-111s will operate the weapon in conjunction with the Ford Aerospace & Communications AVQ-26 *Pave Tack* electro-optical targeting pod.

Pave Tack can also be used with dumb or laser-guided bombs, and with the GBU-15 glide bomb. The television-guided version of the GBU-15, based on a Mk84 900kg bomb, is operational on USAF Tactical Air Command F-4E *Phantoms*. Initial operational testing of the version with an infra-red seeker (as fitted to AGM-65D *Maverick*) is due to be completed by the end of 1984. The USAF has standardised on the GBU-15 family as its interim stand-off weapon and plans to develop a powered version, the AGM-130, to arm F-111s and F-4s. The 24km-range AGM-130 is intended to provide a large increase in capability at low cost, and comprises a standard GBU-15 (including the present data link) with the addition of a rocket motor and, for the dispensing version, a radar altimeter and a facility known as Adjusting Aimpoint Compensation. The last-named allows for the fact that the seeker's view, as seen by the weapon-system operator on his display, is offset from the target in the case of a dispensing weapon. A contract for full-scale engineering development of AGM-130 was due to be awarded in June 1984, with deliveries starting in 1987. The weapon can be based around the Mk84 bomb or an SUU-54 dispenser carrying Aerojet Ordnance BLU-97/B bomblets.

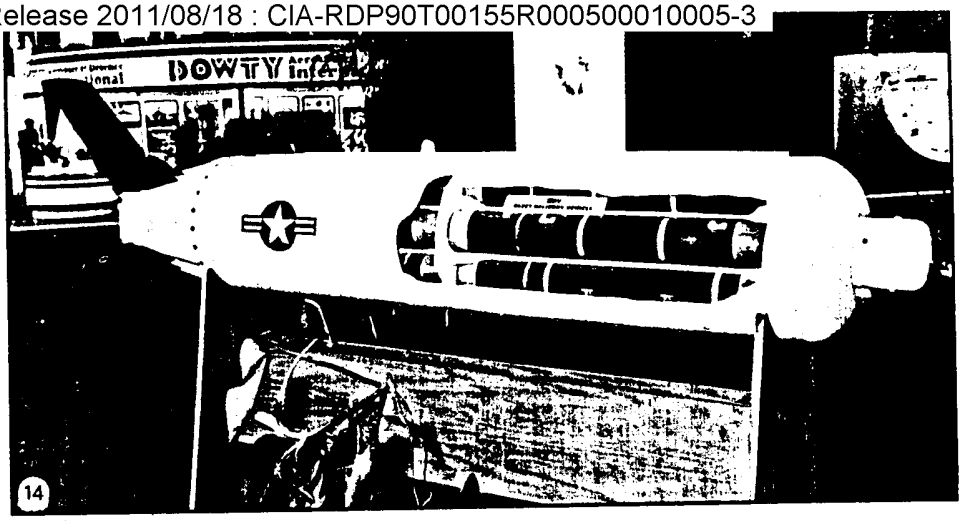
The BLU-97/B also forms one payload for the USAF's new SUU-65/B Tactical Munitions Dispenser (TMD), this combination of dispenser and 202 bomblets — each of which contains a shaped charge, fragmentation section and incendiary device — forming the CBU-87/B Combined Effects Munition (CEM). The CEM will replace a series of earlier cluster bombs and is claimed to provide two to four times the kill rate of the current *Rockeye*.The weapon completed initial operational testing in October 1982 and can be delivered at heights down to 200ft and speeds of 700kt. Up to 19 can be carried by an F-15E. The burst height can be selected in flight by adjusting the time delay and operating height of the proximity fuze, and the spin rate of the dispenser can be selected between zero and 2,500 revs/min to vary the submunition pattern (the weapon is spun up by pop-out canted fins on release from the carrier aircraft).

The TMD can also contain the *Gator* mine family, each dispenser accommodating 72 of the anti-tank version and 22 of the anti-personnel variant. An F-111 can thus deliver some 600 mines over an area of 200m by 300m from 200ft and a speed of 800kt. Another payload for the TMD is the Avco Systems Sensor-Fuzed Weapon (SFW), now in full-scale engineering development. The TMD can contain ten such submunitions, each holding four *Skeet* self-forging fragment warheads. Yet another possible payload for the TMD is the Avco Systems ERAM (Extended-Range Anti-Armour Munition), this combination being designated CBU-92/B. Avco has completed advanced development of ERAM, which deploys up to two *Skeets* when it senses approaching tanks, and the weapon could enter full-scale development immediately, leading to production in some 18 months. No money is available at present, however, and the ERAM program may be handed over to the Army for deployment from helicopters or trucks. This solution would avoid the need for expensive shrinking of the electronics in ERAM that would be necessary for it to fit comfortably into a TMD.

The USAF has approved low-rate initial production of the Texas Instruments *Paveway* III low-level laser-guided bomb in its GBU-24 version, based on a Mk84 900kg bomb. *Paveway* III is designed to operate in poor weather and in a high-threat environment, and can be delivered from level flight at very low altitudes, in a toss mode from stand-off ranges, or in a dive of up to 60°. The use of an autopilot for mid-course guidance allows the pilot to merely sight the target through his windscreen and pickle, without having to track the target. A boosted version, using a rocket motor, has also been proposed.

The US Naval Weapons Center at China Lake is conducting operational testing of *Skipper* 2, a Mk83 450kg bomb fitted with a laser seeker and the same rocket motor as is used in the *Shrike* anti-radiation missile. The addition of a motor allows the weapon to be launched from stand-off ranges.

In the UK, Hunting Engineering is developing an improved version of the BL755 cluster bomb to meet Air Staff



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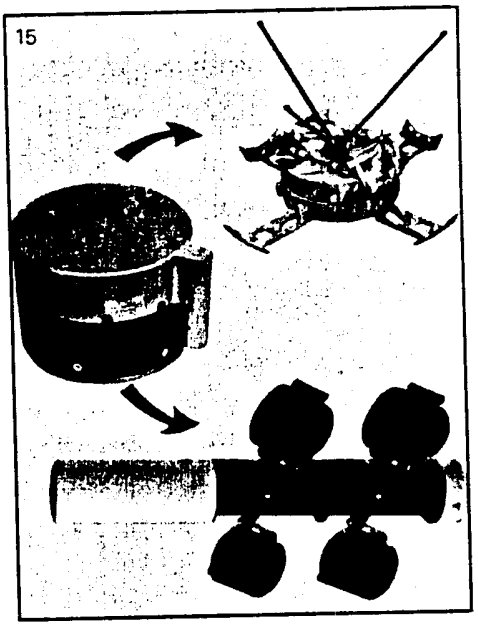
14-16 — The USAF's new SUU-65/B Tactical Munitions Dispenser (TMD) can be loaded with a variety of submunitions including Avco Systems Extended-Range Antiarmour Munitions (ERAM) and Sensor-Fuzed Weapons (SFW — **14** — *photo: Brian M. Service*). ERAM is a smart mine containing two *Skeet* submunitions which it ejects outwards and upwards when it senses approaching tanks, while the SFW deploys four *Skeets* from the air. Photo **15** shows the IR-sensing, top-attack *Skeet* (centre left), ERAM (top) and SFW (bottom). Up to six *Skeets* can also be delivered by conventional IRAAM 155mm artillery rounds (**16**).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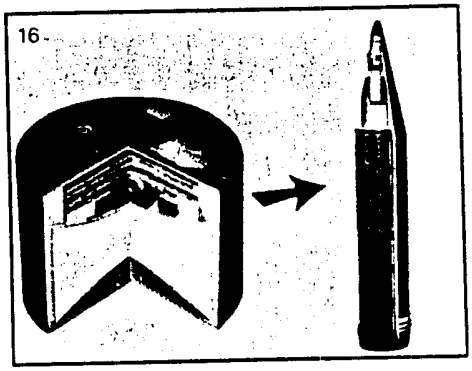
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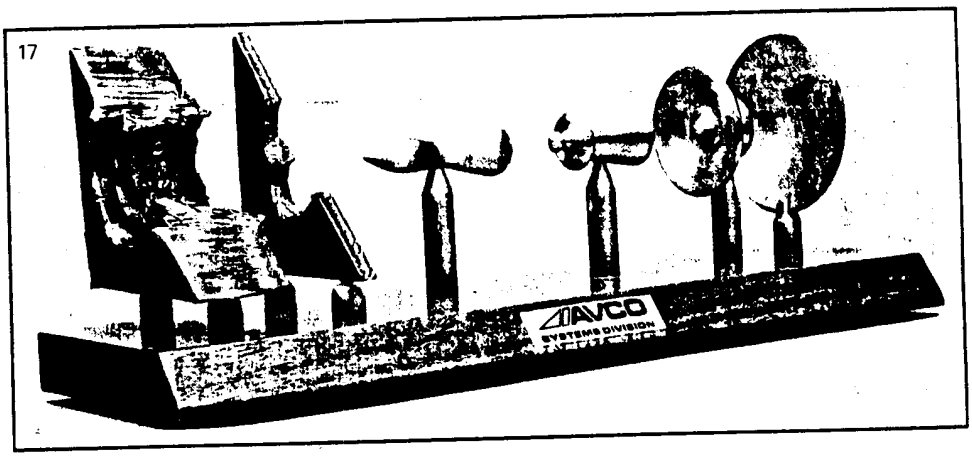
Requirement 1227 (modified). Each of the 147 bomblets incorporates an uprated explosive charge, and a parachute has been added to the rear in order to pitch the bomblet sharply nose-down following weapon release at very low levels.

Air-to-surface weapons used by the French Air Force include Matra's *Belouga* cluster bomb and the Aérospatiale AS.30L laser-guided air-to-surface missile. Matra has launched production of its BGL laser-guided bomb system, which is due to enter service with the Armée de l'Air this year. Firing trials carried out in October 1983 resulted in a bridge pier being completely destroyed by two *Arcole* 1,000kg bombs with the BGL guidance and control kit. A version based on a 400kg bomb is also available.

• **Low-Cost Powered Dispenser**. NATO is now looking towards a future air-launched stand-off weapon for use at short and medium ranges, and expects to sign a memorandum of understanding this year leading to a feasibility study for a Low-Cost Powered Dispenser (LOCPOD). The US, Belgium, Canada, Denmark, Italy and Norway have expressed interest in such a weapon, with a range of some 20km, for service entry in approximately 1990. A pre-feasibility study under Dutch leadership has been completed, and Canada is expected to assume responsibility for the feasibility study. Britain has already drawn up a requirement for such a weapon in the form of Air Staff Target 1238, and has awarded competitive feasibility study contracts to two UK industrial teams led by British Aerospace and Hunting Engineering, respectively. Neither the German nor the French defense ministries have yet established their exact needs, although the Luftwaffe is looking for a weapon in this class to arm *Alpha Jets*, but the industries in those countries are taking the initiative in forming international teams to develop suitable technology.



17, 18 — The *Skeet* submunition features an IR seeker and an explosively formed penetrator (or self-forging fragment) warhead. Formation of the penetrator is shown in photo **17**, while photo **18** shows a *Skeet* in action.

MBB and Matra have agreed jointly to provide company financing for development of the project known as CWS (Container Weapon System) by the German company and as *Apache* (Arme Planante à Charges Ejectables) by the French firm. Dornier and Brandt Armements have also agreed to collaborate on a weapon referred to as the Short-Range Stand-Off Missile (SR SOM) and *Pegase*, respectively (see *IDR* 6/1984, p.796). Franco-German governmental financing of one or more of the proposals may be made available in 1986.

Techniques suitable for incorporation in CWS/*Apache* have been developed as part of a US-German technology program under which MBB and Brunswick have collaborated on the Low-Altitude Dispenser (LAD, *IDR* 6/1982, p.804). Flight trials of the LAD 1 vehicle, for which MBB contributed the warhead section and its submunitions, were carried out during 1982 at Eglin AFB. Inert KB44 bomblets (as developed for the MW-1) were dispensed from the unpowered LAD 1 vehicle to check the ejection performance. These tests have been followed over the last year or so by trials with the 1,360kg

Remotely piloted vehicles

Several NATO countries are developing RPV systems to provide intelligence information and to aid in acquiring and engaging battlefield targets. The US Army's major program in this field is *Aquila*, being developed by Lockheed Missiles & Space Co. Each Army division will have two centralised launch/recovery sections (CLRs) with associated forward control sections (FCSs). The RPV itself carries a stabilised daylight television camera and a laser rangefinder/designator. With the RPV flying at a height of 3,000ft, and the camera's sightline 25 degrees below the horizontal, the ground area being imaged at any given time mesures 700m across by 1,250m deep and an area of 25km^2 can be searched in five minutes. Sensor information is transmitted back to the FCS via a jam-resistant data link.

Aquila is intended mainly for artillery fire adjustment, replacing manned aircraft in this role, and to designate targets for attack by *Copperhead*, *Hellfire* and laser-guided bombs. A prototype system has been deployed at Fort Hood in order to provide operating experience. The day-only variant is scheduled to enter production next year, and to be fielded in quantity during 1987. Full-scale engineering development of the associated FLIR system is planned to start this year, allowing a night capability to be added to *Aquila* in 1989.

Matra and MBB have agreed to collaborate on an RPV system and have submitted proposals to the French and German governments. The *Brevel* program, which has absorbed Matra's *Scorpion* and MBB's *Tucan* projects, would use an RPV weighing 100-150kg and having a range of 50-80km. The payload would comprise TV and/or FLIR, and the system could become operational at the end of this decade.

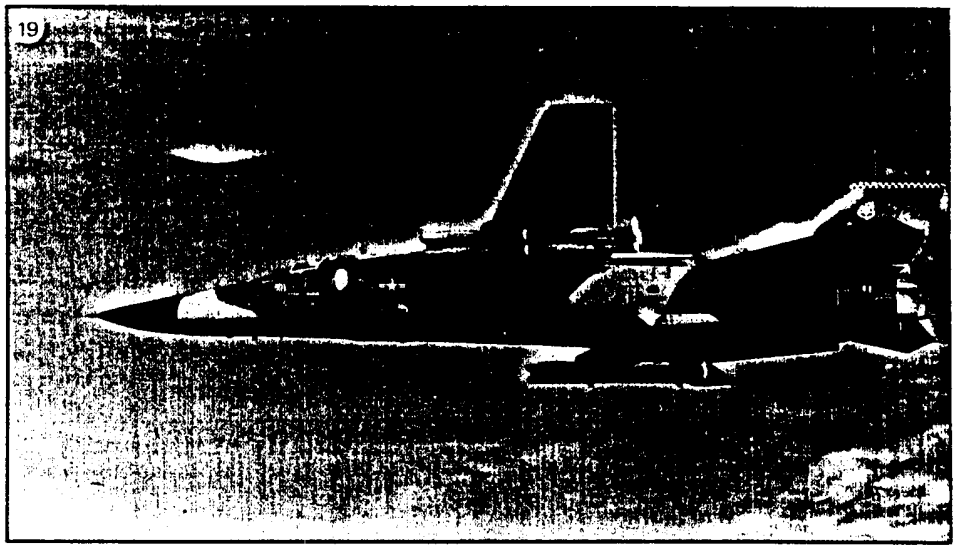
The British Army has a similar program, *Phoenix*, which will use air vehicles deployed at corps level to conduct battlefield surveillance and to find targets for attack by artillery. The main sensor will be a FLIR.

LAD II, which uses gas generator dispensing (as in the MW-1) to reduce costs and provide greater flexibility. MBB has developed a standard dispensing unit containing four tubes (ejecting two submunitions to each side), and these can be attached mechanically to build up a weapon of the size desired. Smaller, two-tube, modules are also available.

The LAD flight path is controlled by an autopilot and altimeter, using four control surfaces on the rear fins, but it would be fitted with an inertial navigation system. It can be pre-programmed on the ground or in flight, with data passed via a MIL STD 1553B digital data bus. Several LAD flight profiles have been tested, including low-altitude level delivery and "pop-up" for a steep dive attack, to allow kinetic energy runway penetrators to be released. Launch speed limits are 300 to 600kt (556 to 1,112km/h) and, launched at 600kt, the LAD can manoeuvre to a target up to 2.5n.m. (4.5km) off the aircraft launch axis. Maximum launch range along this axis is 5.5n.m. (over 10km) but Brunswick claims that this increases to 13n.m. (24km) in the powered version.

A variety of submunitions have been tested, including the US Kinetic Energy Penetrator and MBB STABO to attack runways, the US Sensor Fuzed Weapon using Avco *Skeet* submunitions and MBB's KB-44, both anti-armour, and the US Anti-Material Incendiary Submunition (AMIS). Two dispensing systems were used. One was a variant of the 135mm (5.3in) tube dispenser used in the MW-1, which employs a sequencer-controlled cartridge gas generator to eject the individual submunitions laterally in a controlled pattern. The second was a Brunswick-designed four-bay airbag system which simultaneously ejects all of the submunitions in a bay.

A further series of LAD demonstration flights, funded as a US Foreign Weapons Evaluation program, will start in early 1985. This will test three submunition dispensing systems, including one each from Dornier and MBB, used with a variety of German submunitions.

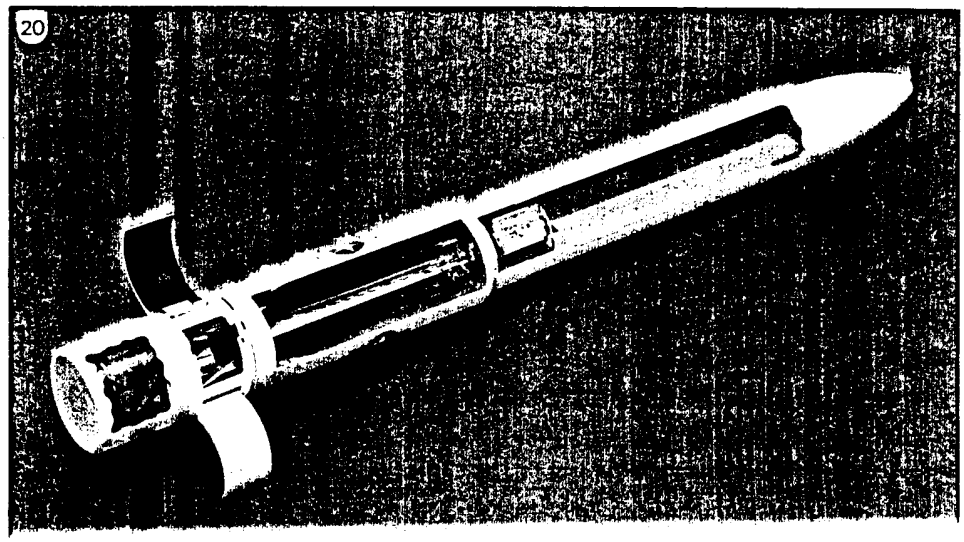


Three LAD vehicles are to be built. One will be similar to the earlier, slab-sided unit, while two others will be more aerodynamically refined, and presumably lighter, as they are claimed to be suitable for carriage by all USAF strike aircraft. The test vehicles will be recoverable for re-use.

MBB's dispenser modules form the 2m-long centre section of the CWS/*Apache* which can contain up to 48 tubes for German submunitions of 132mm diameter, or 44 of 184mm calibre to accommodate Matra's submunitions. The MBB ordnance section can be loaded with any of the submunitions planned for MW-1 (see above and below), while the French version can house Matra's *Mimosa* fragmentation submunition for use against troops or light vehicles, the *Arcadie* "semi-smart" anti-tank weapon, or mines. Alternatively, 12 *Samanta* runway-cratering munitions could be mounted lengthwise within the missile's centre-section.

CWS/*Apache* is expected to fly in 1987-88, with troop trials following in 1989-90. Three basic versions are planned: an unpowered dispenser with stub wings and a range of 7-15km, depending on the release height and whether a toss delivery mode is used; a derivative, also unpowered, with flip-out wings to give a range of 25-30km; and a powered weapon with a range of some 50km. Matra sees CWS/*Apache* as the natural successor to its present family of specialised air-to-surface weapons such as *Belouga* and *Durandal*.

Dornier is already collaborating with Hunting Engineering and Honeywell on MLRS Phase III studies, and, together with Brandt Armements, this co-operation is continuing with *Pegase*/SR SOM. Aérospatiale is also expected to join the team. The weapon typically carries 24 submunitions, of which several types will be available. Dornier regards millimetre-wave radar guidance as being too expensive for this application, as well as being unproven technology that may not be available in time for SR SOM. A modified SADARM submunition is therefore a prime candidate for the weapon. Detection range would be extended to increase the size of the target-acquisition footprint from some 80m radius to about 600m, allowing the target signature to be analysed before attack. A steerable parachute would also be added to the submunition, allowing it to turn and follow a target.



19, 20 — The USAF has ordered 3,000 Matra *Durandal* boosted anti-runway weapons, shown here on an F-111 (**19**), for the counter-air mission. Up to eight of Avco's Boosted Kinetic Energy Penetrator (BKEP) anti-runway weapons (**20**) could be dispensed from a TMD for the counter-air mission, together with British HB876 mines used in the JP233. BKEP is now in full-scale engineering development for the USAF as a potential follow-on to *Durandal*.

The increased footprint size would permit navigation errors of 300-400m for the dispenser itself to be tolerated, and a kill rate of 30 percent could be expected against a tank column moving along a road. Test vehicles demonstrating aspects of SR SOM technology are due to start flight trials next year.

● **Suppression of enemy air defenses**. The success of any deep attack mission that requires the use of penetrating aircraft, and of close-support engagements, depends on suppressing enemy air defenses. The third MoU covering tactical air-to-surface missiles that NATO expects to be signed this year relates to SRARM (Short-Range Anti-Radiation Missile), a high-speed ARM intended to be deployed in the early 1990s for self-defense of tactical aircraft. Members of the Alliance that have expressed interest in such a program comprise the US, Canada, Italy, Holland and Britain. The US is deploying the Texas Instruments HARM as its standard weapon in this category (*IDR* 11/1983 pp.1585-1588), and is developing the *Sidewinder*-based *Sidearm* I and II as low-cost interim weapons to protect tactical aircraft. The German Navy has also selected HARM, which is being promoted by MBB as standard armament for the projected Electronic Combat and Reconnaissance (ECR) version of *Tornado* for the Luftwaffe. The Royal Air Force has selected the British Aerospace Dynamics ALARM as its new lightweight anti-radiation missile, to enter service in 1987, and Matra is proposing its ARMAT as a dedicated long-range ARM (derived from *Martel*) for the Armée de l'Air.

NATO's Air Force Armaments Group is studying US proposals for a concept known as Counter Air 90, which envisages the use of ballistic missiles to attack enemy air bases in the first few hours of a European war. Several companies have put forward proposals for such a weapon, referred to as *Axe* by the US Department of Defense. Martin Marietta has proposed CAM (Conventional Counter-Air Missile), using an extended-range *Pershing* II carrying a dispenser warhead. The US company has discussed CAM with Hunting Engineering, which is carrying out studies related to the British MoD's Air Staff Target 1236 for a future airfield-attack missile. Lockheed's studies to meet the *Axe* requirement have centred on its proposed Ballistic Offensive Suppression System (BOSS), based on the *Trident* C4 missile. Following a cold launch from a silo and booster separation at a height of 80,000ft and Mach 6.7, the weapon would reach an apogee of 160,000ft at Mach 5.5. Stellar updating of the guidance system at 110,000ft/Mach 6 is followed by a mid-course glide of the warhead section at its maximum lift/drag ratio. The vehicle then turns on to its required azimuth and executes a terminal pull-up at 20,000ft and Mach 2.4 to dispense submunitions.

Most European countries are opposed to such an exotic solution using ballistic missiles, preferring to rely on cruise weapons and manned penetrating aircraft for the next generation of airfield-attack weapons. A number of new weapons optimised for this role are now coming into service, which will

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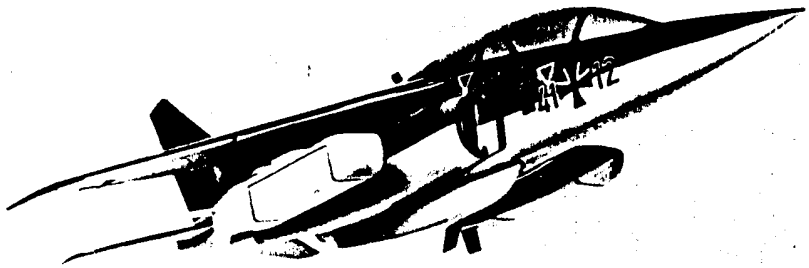

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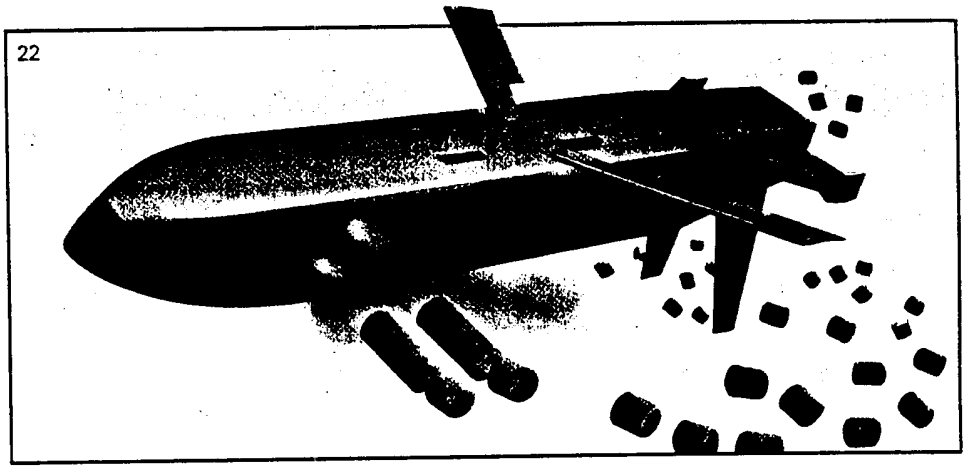


21,22 — NATO is expected this year to start feasibility studies for a Low-Cost Powered Dispenser (LOCPOD) with a range of about 20km, for service entry in about 1990. The British RAF has already awarded competing study contracts to teams headed by Hunting and British Aerospace to meet its Air Staff Target 1238. Two Franco-German teams have also been formed to compete for the anticipated NATO contracts for LOCPOD, as illustrated here in two artist's impressions. **21** shows two Dornier-Brandt Armements *Pegase*/SR SOM powered dispensers beneath the wings of a Lufwaffe *Alpha Jet*. The MBB-Matra CWS/*Apache* is shown (**22**) dispensing MBB bomblets developed for the MW-1.

NATO's counter-air capabilities.

The British Royal Air Force will introduce the Hunting Engineering JP233 dispenser weapon over the next few months (*IDR* 4/1984, pp.485-488). A *Tornado* can carry two complete JP233 weapon systems containing a total of 60 SG357 cratering submunitions and 430 HB876 area-denial mines. Luftwaffe *Tornados* will carry MW-1 dispensers loaded with the STABO (Startbahnbombe) cratering munition, the MUSPA (Multisplitter-Wirkkörper, Passiv) fragmentation mine using acoustic fuzing to attack taxiing aircraft, and the MUSA and MIFF mines also carried in MW-1 for the anti-armour role (see above). Development of this submunition combination, known as HZG II, is scheduled for completion at the end of 1985 and to become operational in 1987. Negotiations now under way with the Italian Air Force are expected to lead to that service arming its *Tornados* with MW-1s carrying HZG II submunitions for airfield attack. STABO has already been tested by the USAF at Eglin AFB under the Foreign Weapons Evaluation Program and is to be further demonstrated there in October 1985 from a *Tornado*. The MUSPA mine will also be examined at Eglin under the same program.

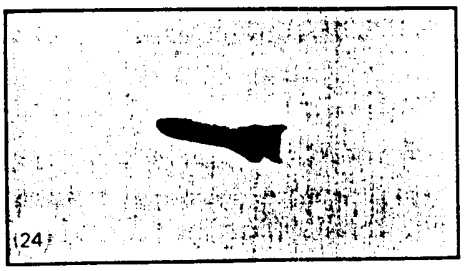
RTG has carried out initial development of two further submunitions that could be incorporated in MW-1. The ASW (Anti-Shelter Weapon) employs a similar principle to that of STABO, using a tandem arrangement of warheads to blow a hole in a hardened aircraft shelter (HAS) so that the secondary grenade can detonate within the HAS itself. Another submunition, LASSO, erects itself on legs and deploys sensors so that it can detect passing vehicles and penetrate their sides by means of a hollow charge. Further development of these submunitions depends on money being made available.

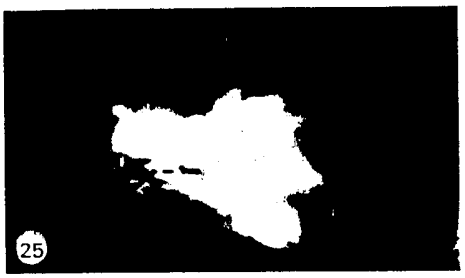
In September 1983, after more than three years of competitive evaluation, the USAF selected the Matra *Durandal* as its interim anti-runway weapon for Tactical Air Command. *Durandal*, designated BLU-107/B by the USAF, has been in production since 1977 for the Armée de l'Air and export customers.

Orders and options now total some 29,000 rounds, including approximately 3,000 for the US. Up to 24 can be carried by an F-111 (although 12 is more typical), and the weapon is also likely to arm F-4s and F-16s.

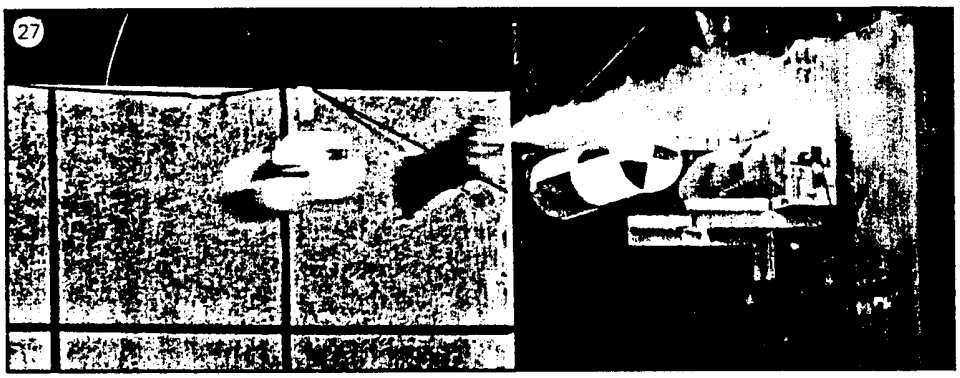
In addition to buying *Durandal*, the USAF has funded full-scale engineering development (to be completed in April 1985) of the Avco Systems BLU-106/B BKEP (Boosted Kinetic-Energy Penetrator) as a specialised airfield-attack submunition. BKEP was originally planned to be carried by the AGM-109H MRASM medium-range air-to-surface missile, and following the cancellation of that weapon there were proposals that dedicated future counter-air versions of the GBU-15/AGM-130 family could accommodate 15 to 17 BKEPs in a dispenser vehicle. This proposal has died through lack of funding, however, and a possible first application of the submunition is in the Tactical Munitions Dispenser. *IDR* understands that the USAF Armament Division at Eglin AFB may look favourably on a proposal for a version of the TMD loaded with eight BKEPs and the HB876 mine as used in the British JP233 anti-airfield dispenser. The two submunitions have the same diameter — a legacy from the days when JP233 was a joint Anglo-American project — thereby aiding integration into the TMD. The TMD can be tossed for 1,500-2,000m but is essentially a fly-over weapon. Although a stand-off missile such as LOCPOD or LRSOM would seem more suitable as a delivery vehicle for BKEP, senior decision-makers within Tactical Air Command are at present committed to penetrating aircraft.

Avco was due to have delivered nearly 60 trials rounds of BKEP, including some complete submunitions, by July 1984 for testing at Eglin and at the company's facilities on Cape Cod. Production could start within six months of FSED being completed. BKEP is designed to defeat the hardest targets, which are not necessarily those for which European-developed weapons are intended. The USAF, with its worldwide responsibilities, needs a weapon that will destroy air bases in Siberia and on the Kamchatka and Kola peninsulas as well as in Central Europe. US experience of building airfields in Alaska during World War 2 has shown just how





23-27 — The USAF continues testing of MBB and Dornier submunitions from powered Low Altitude Dispensers (LAD) developed by Brunswick (sequence **23-26**). Unlike the MBB submunitions, those developed by Dornier are carried longitudinally and ejected sideways, with separation between submunitions being achieved by means of pyrotechnically-initiated air bags (**27**).



...ay can be when it is constructed by digging a trench down to the permafrost layer in summer, filling it with gravel, tamping down and topping with concrete or tarmac. The size of hole made by an anti-runway munition against such a target is not as important as creating heave to produce slabs that offer no purchase for a bulldozer blade.

Battlefield data management

NATO's intelligence capability is now good enough to provide detailed analyses of Soviet exercises, allowing the Alliance to pinpoint vulnerabilities, but deep attack using conventional weapons is possible only if accurate and timely battle-management data are available to all levels of command. Over the past five years or so the US Department of Defense has sponsored three series of experiments to demonstrate that deep attack is feasible.

The first series, designed to show that it is possible to locate targets and vector attacks with sufficient accuracy for conventional weapons to be used, involved *Pave Mover* radars for non-emitting targets, PLSS (the Precision Location Strike System) for emitters at the upper end of the frequency range, and CELT (the Coherent Emitter Location Testbed) for lower-frequency radio systems. The results have been incorporated into the JSTARS program (see above) and into the US Army's *Improved Guardrail* system (using RC-12D aircraft) to cover lower-frequency emitters.

A second series of trials, the *Assault Breaker* program, demonstrated a ballistic delivery system and the use of smart submunitions. The third element, relating to information management in near-real time, has involved a number of developments — all of which have been tested in Europe. TRW, on behalf of the US Army and USAF, has been responsible for the Battlefield Exploitation and Target-Acquisition (BETA) system and Limited Operational Capability Europe (LOCE) programs. BDM developed the Army's TAPS (Target Analysis And Planning System), using Apple microcomputers to assist battlefield planning, and RCA provided a computer-based signal-sorting system for emitter location.

These programs have led on to the Joint Tactical Fusion (JTF) program, involving the USAF and Army, which was intended to complement JSTARS and JTACMS — although the re-alignment of Air Force and Army responsibilities has thrown the program into a state of flux. For the interdiction mission, JSTARS would have provided the targeting sensor, passing data to the JTF network and also cueing and guiding attacks by JTACMS. The JTF program was allocated some $600 million for R&D alone in 1985-90, with an interim capability becoming available in Fiscal Year 1986 and the full system in Fiscal Year 1990. ✦✦