

acquired to replace the C-47s in 1984. Of the other three, one was damaged in a landing accident at Concepcion in 1998 and two have been heavily cannibalised for spares. There are plans to return all three to service as and when budget restrictions allow. It is also hoped to purchase a single CASA 212-400 with full medevac capability for delivery in the near future. The unit has one surviving C-47 on strength in potentially airworthy condition, and is responsible for the operation of the VIP/Presidential flight with its long-serving Twin Otter and a single Boeing 707. Both aircraft are kept in pristine condition, although the financial implications of operating the Boeing mean that it is occasionally chartered out to private companies to offset the costs involved.

Grupo Aereo de Transporte Especiales (GATE)

The home of military aviation in Paraguay since 1926, the historic grass airfield at NO Guazu houses two groups of the FA, including GATE, and is situated across the road from Silvio Pettrossi International Airport. The unit was formed in 1988 to fly communication and liaison duties as well as provide search and rescue (SAR), parachute dropping and medevac capability. It operates a variety of single and twin-engined Cessna and Piper light aircraft, (Cessna U206, 210N, 402B and Piper PA-32R) as well as a pair of PZL 104 Wilgas, only one of which remains airworthy (the other suffered a landing mishap in 2000). It also operates and maintains three aircraft on behalf of the Army - a Beech Baron, Cessna 206 and Cessna 310.

Grupo Aereo de Helicopteros (GAH)

The GAH, also based at Nu Guazu, was formed in 1988 and provides the Air Force with a rapid reaction force to carry out anti-narcotic and humanitarian missions in conjunction with the Army. Initial rotary-wing operations were flown by Bell 47/OH-13 as long ago as 1955, and 14 of the type were used by the Helicopter Section in the 1960s, joined later by a pair of Miller UH-12s and UH-1Bs. More recent equipment has been based around four Brazilian-built Helibras HB.350B Esquilos: three are still in use and can be armed with two gun or rocket pods if required. Two UH-1Hs donated by Taiwan in 1996 have recently been supplemented by six more from the same source, although one of the original pair was lost in an accident in 1998. For training purposes, the unit also has a Hughes 300, though this is seldom flown. An Agusta A109A, purchased in 1994 for Presidential use, was also flown by the GAH until a couple of years ago.

Grupo Aereo Instruccion (GAI)

Until 1997, all training was undertaken at BA Nu Guazu by GAI and prior to that, at the Escuela de Aviacion Militar. Since 1997, the unit has been relocated to a newly-constructed base at Concepcion some 186 miles (300km) to the north of Asuncion. Current equipment consists of eight T-35A and four T-35B Pillans, acquired from ENAER in 1990 to replace the ageing T-23 Uiraparus and T-25 Universals. Pilots typically fly 120 hours on the Pillans before progressing to the GAT's T-27s at Silvio Pettrossi. Budget constraints affect the number of aircraft available for use at any one time, and several have been stored, or cannibalised for spares.

afm AVIACION NAVAL PARAGUAYA



Two Cessna 310s were acquired locally in 1988/89 and are operated by GAPROGEN, both for multi-engine training and for light transport duties.

A LAND-LOCKED country bordering Brazil, Argentina and Bolivia, Paraguay may not seem an obvious candidate to operate a naval air arm. Despite its lack of coastline, however, the country has a substantial river system, consisting principally of the Parana and Paraguay rivers, the latter forming a significant part of the border with Argentina.

In 1929, following a Presidential decree, a small aviation element was established as part of the Navy, initially in response to the threat of war with Bolivia. The ensuing conflict involved the Navy's first aircraft, a Savoia Macchi Cant 10, and later a pair of float-equipped Macchi M18ARs, the latter performing the first night-time bombing mission flown in South America.

The newly-formed Aviacion Naval Paraguaya was based at a site adjacent to the Paraguay river, in the Sajonia district of Asuncion, although many flights were operated from lakes and rivers throughout the country. In the ensuing years additional equipment was added, including a pair of NAF N3Ns obtained under a Lend Lease agreement with the United States, three RC-3 Seabees and a similar number of Grumman JRF-5s. Although one of the latter was lost during its delivery flight, a further Goose was later donated by the Argentine Navy.

Three Vultee BJ-13s were acquired during the 1960s, along with a PA-12 and the first of many Cessna aircraft: a pair of U206As arrived in 1966 followed by a further two in 1968, these being exchanged for the remaining Geese. In the 1970s, a single T-6 and SNJ-3 were donated by Argentina and served until the end of the decade. By this time the first helicopters had entered service - four Bell OH-13Hs acquired from the US under the Military Assistance Programme (MAP) in 1973. A single Cessna

210M and a pair of Cessna 150Ms were also acquired during the 1970s. The OH-13s were returned during the 1980s, though the Cessna 150s and Cessna 210 are still in use today. The 1980s saw the addition of a single C-47 (once again donated by Argentina), two Hitler UH-12s donated by the Chilean Government, a single Cessna 401B and a pair of Cessna 310s.

Perhaps the most significant addition was a pair of Helibras HB.350B Esquilos direct from the Brazilian factory. Capable of carrying gun and rocket pods, they added a new dimension to the service's capability, and were involved in the action to overthrow President Alfredo Stroessner: both remain in service today with the Escuadron Helicopteros at Sajonia. A single patrol vessel, the Itaipu, is also capable of helicopter operations. In the early 1960s a large part of the Sajonia Naval Base was absorbed into the expanding city of Asuncion and the base became restricted to helicopter operations only. All fixed-wing flying has since been based at Silvio Pettrossi International Airport and is currently under the control of GAPROGEN (Grupo Aeronaval de Propositos Generales), which operates a single Cessna 401, two Cessna 310s and a single Cessna 210, and GAEN (Grupo Aeronaval Entrenamiento) with a pair of Cessna 150Ms. Despite severe budget restrictions, the service maintains a high standard of training and maintenance and regularly flies transport, SAR and patrol duties in support of naval operations.

AVIACION NAVAL PARAGUAYA AIR ORDER OF BATTLE

Escuadron	HB.350B Esquilo	Sajonia
Helicopteros		
GAPROGEN	Cessna 210/310/401	Silvio Pettrossi
GAEN	Cessna 150M	Silvio Pettrossi



A pair of HB.350 Esquilos were purchased new from Helibras in 1989. All helicopter operations come under the control of the GAH. The aircraft operate from Sajonia Naval Base, located beside the Paraguay River in Asuncion.

Evidently caught looking the wrong way as a Tornado scorches over the trees, this SA-8 crew was setting up a trial at the time! The vehicle was working off its own internal power, hence the blue haze of diesel smoke around it. In reality, the aircraft would not have got this close to such a highly-effective missile system.



PREPARING FOR

WAR

THE ROLE OF THIS STATION IS TO TRAIN AIRCREW TO FIGHT AND SURVIVE IN A HOSTILE ELECTRONIC WARFARE ENVIRONMENT

AFMs **Alan Warnes** visits RAF Spadeadam, where aircrew go to hone their electronic warfare skills. Steve Fletcher took the photographs.



Previously 820 (c/n 31407) of the former East German Air Force, originally delivered to Marinefliegergeschwader 28 at Laage in December 1986, this Su-22M4 Fitter-K is now parked on a hard-standing overlooking the old mock airfield at Prior Lancey. It came to Spadeadam via WTD 61 at Manching and A&AEE Boscombe Down.

IF YOU seek peace, be ready for war" is the motto of RAF Spadeadam, the home of the RAF's Electronic Warfare Training Range (EWTR). This is the only EW tactics range in the UK and the biggest in Europe (the other is the Polygon EW range in Germany). As the Base Commander, Wg Cdr Gordon Robertson told the author: "Electronic Warfare (EW) is not sexy - it does not have the same high profile as smart weapons which hang from the RAF's aircraft and which can give spectacular results when dropped or fired". But EW is necessary, and never more so than at present when so many RAF aircraft are based overseas, patrolling skies that could be hostile. When the Cold War effectively came to an end in 1990, the only overseas operation in which such action might arguably have been possible was the Falkland Islands. Today the RAF has airborne assets flying from Afghanistan, Bahrain, the Balkans, Falkland Islands, Italy, Kuwait, Saudi Arabia and Turkey. Most of these operations involve aircraft flying in airspace where hostile ground-based air defences are ready to unleash surface-to-air missiles (SAMs). Aircrews and aircraft must be protected and thus need to be trained in the art of electronic warfare.

EWTR

Obviously, it can be dangerous to practise tactics over hostile territory, so the 9,000 acres (2,700 hectares) of land in Cumbria which make up the Spadeadam EWTR are a vital resource. The EWTR can be found in Low Flying Area 13 and Danger Area D 510, near Carlisle, and is usually active every week-day. The RAF took over the land in 1976 after development of the independent ICBM Blue Streak was abandoned. For 60 days each year, aircrews use the Air

Weapons Range at Whitley Sike, part of the Spadeadam complex, to prosecute an attack and drop practice bombs, while being 'attacked' by threat systems on the ground. In recent years, the threat systems at the range have been radically enhanced by the arrival of 'real' systems, such as the ZSU-23-4 *Gun Dish*, SA-6 *Straight Flush* and SA-8 *Land Roll* fire control units of the associated *Gainful* and *Gecko* air defence missile systems, brought over from East Germany by the United States when the Berlin

"We need to know what kind of threats are the likely threats, not necessarily to improve Spadeadam range, but to provide the best EW training for the three main UK forces."

Wall came down. As well as these systems, the EWTR inventory includes emulator and simulator threat systems. The US Air Force left Spadeadam 18 months ago, but has leased the equipment to the Royal Air Force.

Pilots can fly their aircraft through the range and practise defending themselves against the kind of ground-based air defences against which they can expect to go into combat. As one officer told *AFM*: "All the wrong kind of people use the kind of defences we have here". A squadron can make a prior booking for a slot - which can vary from 10 minutes in a fighter to an hour in a helicopter - on the day of use, or even while in the air. Once the slot time has been confirmed, the range must be informed of the particular threats the user wants to train with and how the user wants them presented. This is arranged by applying a designation to each threat system, which the person making the booking will confirm. The simulators are very

mobile and the scenarios on the range can easily be varied. To make training more realistic, Smokey SAM simulators can be fired into the sky - however, these are currently unavailable and the RAF is believed to be considering a cheaper alternative. There are also a large number of decoys, including *Mystere IVAs*, T-33As and a sole Su-22, the bulk of these located at the so-called 'Collinski' mock air base -, Collins was a former Spadeadam CO, and the 'ski just adds a Russian factor!

Spadeadam can track and provide debriefs to the squadrons for up to eight aircraft by means of a Graphic Post Mission Report after the flight. The crews can decipher from the reports whatever they want as the EWTR will never say that they shot the aircraft down - interpretation as to how they fared is down to the aircrew. Low flying is monitored by a mobile Skyguard radar, which is moved around the country to catch low-flying RAF jets - to "sneaky-beak on them" as one officer put it. Illegal low flying is an offence the RAF takes very seriously and pilots can be severely reprimanded if found guilty of such an offence by the service.

Real Threat Systems

There are three main categories of threat at the EWTR: the real systems, emulators and simulators. The real systems - the ZSU-23-4s, SA-6 and SA-8 systems - were the ones which most intrigued *AFM*. These are ex-German Air Force systems and are operated by personnel from the GAFE (German Air Force Equipment) section, whose 30 personnel are split between the three different systems. Uniquely in the RAF, the engineers are also the operators. At present, GAFE personnel receive 'on the job' training as there are no formal training courses, though there may be soon. Earlier in the year, several Germans employed at the Polygon EW range, near Ramstein, came to familiarise the unit with the systems' doctrine, because although the UK personnel could operate them, there were a number of elements they were unsure about. GAFE operators agreed that this greatly aided their understanding of the systems and they would like to see such visits become a regular arrangement.

SA-8s started production in 1974 and continued until 1991. They are designed to track, acquire and launch SAMs. Once a target is located, the operator can track it and then fire the missiles. There are, of course, no real missiles at the EWTR but once the operator simulates a firing, the pilot will hear it on his radar warning receiver (RWR). The SA-8 SAMs have a threat range of just over seven miles (12km), though they can be tracked for 12 miles (20km). Once in



Adding further realism to the military hardware at Spadeadam is a 'convoy' of defunct Russian equipment, which includes a number of electronic box-body vehicles, including this King Pin trailer-mounted jamming system. Although no longer functional, the vehicles represent the type of equipment still in use in potentially hostile theatres and are a valuable adjunct to the real electronic threats.



This non-operational Tin Shield 3D E/F-band target acquisition radar is mounted on high ground near the old mock airfield at Prior Lancey, with an associated control van alongside. Yet another example of the range's visual realism, it adds to the value of the electronic threats from real systems, emulators and simulators.

range, and once the location of the aircraft is correct, the missiles can be launched. The SA-15 - the upgraded development of the SA-8 - can track multiple targets, carry more missiles than the SA-8 and has two operators. However, an SA-15 system is unlikely to find its way to Spadeadam unless many more potential adversaries also acquire the system, thus creating a need to practise defensive tactics.

The GAFE equipment is a masterpiece of mechanical engineering, according to one member of the unit - though very challenging. "All three systems are valve technology so we have to really think about how to find the faults - and in addition to that, the diagrams we have to work from are 30-40 years old, so you can imagine the difficulty in trying to rectify the problems. Spare parts are also hard to acquire. This is why three of the five SA-8s are being used for spares." Anyone who climbs into the cramped and stuffy spaces of these vehicles soon understands why, under health and safety regulations, RAF operators cannot spend more than an hour in such conditions - even less if the temperature is above 25°C. Spare a thought for the operators of these systems in locations the RAF would term 'hostile environments' - they are likely to stay inside the vehicles for as long as it takes to do the job. Add nuclear, biological and chemical (NBC) protective gear and personnel have a pretty tough time.

A significant amount of time elapsed between the arrival at the range of the GAFE's equipment (circa 1992) and the date it was put into service - 1995/6 - because of the work necessary to



Most of the real aircraft at Spadeadam have been 're-deployed' to the larger 'Collinski' airfield, but this ex-Belgian Air Force T-33 has been retained in one of the many isolated revetments around the site.

bring them up to western safety standards. For example, the ZSU-23-4 had a metal back panel against which the operator leaned - a mere half-inch (1.27cm) away from cabling which had 25,000 volts running through it! Other systems included cables with similar voltage running between the operator's legs - not a situation the operators were too keen about! Furthermore, the generators on the systems were fuel-inefficient and environmentally unfriendly, so on-board generators were modified and external generators adapted to enable the equipment to run more efficiently. Basic instrumentation was set up on board so that it was possible to see where the threats were looking in relation to the aircraft - extremely helpful during the debrief.

Emulators

These US-built fully-functioning emulator radars can often look like the real thing. The T-1 has a combined system, which emulates the SA-2 *Fan Song* and SA-3 *Lowblow* radars: even the transmission parameters used are the same as the systems they emulate. Since the US

withdrew from the range, the EWTR has taken on the T-1 combined system, a single control cabin with both the radar heads. The SA-2 *Fan Song* radar is currently away on deep maintenance in the USA. There are also two versions of the T-43 emulator, which are the responsibility of the Training Test and Assessment (TTA) Fit: one emulates the SA-6, the other an SA-3. These have similar threat systems to the real equipment but unlike the real thing, they are much more mobile. The SA-6 system, for example, is deployed to Spadeadam's remote coastal site at RAF Boulmer in Northumbria (known as SPACES, Spadeadam Coastal Emitter Site), where aircraft can carry out the kind of evasive measures which are not possible over the range. One of these is dispensing chaff over the sea - chaff cannot be used at Spadeadam as it may not only damage trees but also affect the Newcastle Air Traffic Control radar system. The SA-8 is currently away in the USA, like the SA-2 emulator on deep maintenance, but when it returns it will probably replace the SA-6 on the coast.

There are also two J-Band Emulator Systems (JETS) which can be switched between the SA-8 and ZSU-23-4 and an I-Band Upgrade (IBU) designed to simulate the SA-10 *Crumble* and SA-11 *Gadfly*. None of these have real systems on board, though they can simulate the characteristics of such systems by videoing the aircraft as the operator moves his 'radar'. At present the EWTR has no more modern threats than the SA-10/11. Naturally, the TTA would like them, and a Future Ground to Air Training (FUGAT) study is looking at various ways of improving operational aspects of the SAMs in the future. The EWTR is aware that it needs to progress from the current bunch of SAMs to the kind of threats aircrews can expect to find in coming years. However, few of the countries the RAF would expect to operate against are currently operating systems such as SA-12s and SA-15s. As Wing Commander Gordon Robertson, told AFM: "We need to know what kind of threats are the likely threats, not necessarily to improve Spadeadam range, but to provide the best EW training for the three main UK forces. We can do this by providing a realistic EW environment as well as a dense EW environment."



There are constant reminders around the site that it is as much a conservation area as a military range. This sign is outside the large German Air Force Equipment (CAFE) hangar and provides a fascinating counterpoint to the threat radar systems only a few feet away inside the building.

PERSONNEL



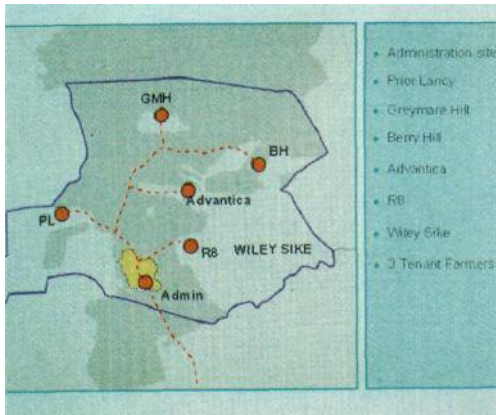
Left: Flt Lt Andy Glover, a Tornado navigator by profession, acts as a roving ambassador for the range's facilities and spends a lot of time visiting the user squadrons, discussing what they require from Spadeadam and how the range can best meet their needs.

Right: The Officer Commanding RAF Spadeadam, Wg Cdr Gordon Robertson, an experienced Buccaneer and Tornado navigator, is determined to ensure that the range and its facilities continue to play a vital part in the provision of realistic EW for RAF and NATO aircrews. In this he is supported by a highly enthusiastic team of RAF and contract personnel who constantly strive to improve on the impressive facilities already in place.



Training Test and Assessment (TTA) Flight

The Spadeadam range falls under the direct control of Strike Command, though the Air Warfare Centre (AWC) based at RAF Waddington (see *RAF Waddington Airshow*, September, p70)



Spadeadam's huge area is broken up into various threat location sites, denoted by abbreviations as shown on the map and covered briefly in the text. The range has three tenant farmers and an award-winning conservation policy for the many species of rare animals, birds and plants on its 9,000 acres.

bears functional responsibility. AWC is kept up-to-date with operational tactics employed by air defence radars via intelligence officers based in-theatre at locations such as Al Kharj (Saudi Arabia) or All Al Salem (Kuwait), where Tornado squadrons are based. These aircraft are regularly tracked while flying over Iraq (see *Iraq Bombed Again*, August, p17) and it was felt that the EWTR would benefit from this functionality control, which ensures that the equipment is operated in the same tactical mode as that operated by the enemy - not necessarily the Russian way. As Wing Commander Gordon Robertson, said: "We do not operate the kit in the same way as it was (operated) in the Cold War, but in the current threat operations. The Training Test and Assessment (TTA) Fit is the hub of what we do here and they are responsible for ensuring the threats are as real as possible".

Fit Lt Andy Coleman of the RAF Regiment is one of the two officers in the TTA office: as Threat Doctrine Officer he acts as the link in the intelligence chain. His responsibility is to ensure that operators use and arrange the SAMs in the way they are being used in certain countries and that the kit is operated in the correct way. "The operators need to use the equipment in the way it should be used," explained Fit Lt Coleman. "I have to remind them that they are SAM operators and they have to practise tactics and manoeuvres as these would be used in war. The only thing they don't do is fire. Very few ground missiles can carry out a hit without guidance, as they need to be guided by an operator. Once the operator starts tracking a target, this represents

the beginning of the interception and you have to support the missile all the way. Some of this equipment is old, but it is robust enough and exists in enough quantity to cause us problems. So I have to ensure that the operator is tracking, firing and intercepting in the way the enemy do, in order to give the aircrews the appropriate training".

The other TTA Flight officer is Fit Lt Andy Glover, a Tornado navigator who, as EW Tactics Officer, is responsible for the tactics employed on the range, ultimately ensuring that aircrews are familiar with threats from around the world. He told *AFM*: "There must be a realistic simulation of what our aircrews come up against, and to assist in this goal we set up the TTA two-and-a-half years ago". He spends much of his time on the road, briefing RAF squadrons on the capabilities of the EWTR and ensuring that they get what they require from the range. *AFM* spoke to a couple of RAF pilots after visiting Spadeadam, and they agreed that although the EWTR is a valuable training range, the regular poor weather in the area means that EW training can be hindered by cancellations and height restrictions. The range can lose up to 60 days a year due to bad weather.

Launching the SAM

Sitting inside the T-1 cabin, the SA-3 operator has three handwheels, used independently for range, azimuth (field) and elevation, with which he can move the radar to the relevant position in an attempt to track the enemy aircraft. He then radiates the aircraft and watches his right-hand screen for a skin return from the aircraft. Meanwhile, he is able to get a closer view of what is on the right-hand screen. Once the operator has the aircraft in his screen's cross-hairs, he ranges automatically and no longer has to concern himself with the range handwheel. After that, it is just a case of keeping azimuth and elevation moving to ensure his target stays on the screen, so that if the aircraft moves to the left he can move his radar to the right. The SA-3 has a very narrow beam width, unlike the wide beam width of the SA-2, so if the aircraft does hard turns the aircraft will generally drop out of the beam. The operator will have to use his initiative as to where he believes the aircraft will head. Once a launch solution can be made, the launch button is pushed: this sets the missile signal generator off and the pilot will then hear the tones on his RWR, telling him that the missile has been launched at him. The SA-3 can track the aircraft for 40 miles (64km), but SA-3 doctrine guidelines, issued by the TTA Fit, only allow a maximum launch range at 19 miles (31km). Usually, the aircraft flies straight at the radar.

ZSU-23-4 Shilka

DURING THE Cold War, this formidable self-propelled anti-aircraft artillery (AAA) system was feared in equal measure for its rate of fire and for the huge numbers deployed in Europe by the armies of the former Warsaw Pact. It is currently still in service in some 30 countries, many of whom are not demonstrably friendly to the United Kingdom, and it remains a significant threat to low-level air operations by fixed wing jets and helicopters. This provides the rationale for its use at Spadeadam, where its fully-functional Gun Dish fire-control radar produces electronic realism in the midst of numerous decoy systems deployed around the range. The RAF technician/operators at Spadeadam are taught to use the systems in much the same way as an adversary would, providing aircrews with a highly realistic electronic warfare scenario as they pass through the range and one for which they must have well-

practised countering tactics.



SA-6 Gainful

LIKE THE associated ZSU-23-4 and SA-8 systems, the SA-6 *Gainful* surface-to-air missile complex was once the greatly-feared medium-level component of the Russian and Warsaw Pact 'layered' air defence network, which covered every layer of airspace from sea level up to 100,000ft (30,000m). Although Russia has subsequently deployed more modern missile complexes which exceed the performance of the SA-6, the older system is still used by some 20 countries, of which around half are potentially inimical to UK and allied interests. Like the other two 'real' threat systems therefore, the SA-6's *Straight Flush* fire control radar at Spadeadam helps to reproduce a real battlefield electronic environment, indistinguishable from that of a

potentially hostile adversary. Added realism comes from the application of specific 'doctrine' guides by the operators which define the minimum and maximum engagement and kill ranges for the systems, thus ensuring that aircrews are aware of the systems' limitations, as well as the validity of their own reactions.



SA-8b Gecko

FILLING THE gap between the shoulder-launched SA-7 *Grail*, the wheeled self-propelled SA-9 *Gaskin* and the tracked SA-6 *Gainful* systems, the SA-8, like the ZSU-23-4 mobile AAA, is still widely used by many nations which are potential adversaries of the UK and her allies. Also, like many well-designed weapons systems, it remains a significant low-altitude battlespace threat more than a quarter of a century after its first appearance, and is likely to remain so for some years to come. Having fully-functional *Land ffo*/fire control radars (but no missiles!), Spadeadam's highly mobile and virtually self-contained SA-8s can be moved around the range to create new threat sites in a very short time, adding to the realism of its use. The power supplies on Spadeadam's examples have been modified to feed off Western mobile generators, which are

environmentally more 'friendly' than the Russian systems.

ALAN DAVIES



In addition to the various radiating threat systems, which can be located virtually anywhere in the range area, there are also large numbers of locally-made mock-up systems, representing tanks and armoured fighting vehicles. For greater realism, these can be provided with a heat source inside the body of the vehicle to reproduce an appropriate infra-red signature.

1



2



3



PREPARING FOR WAR

[1] U Down for maintenance during AFM's visit, this Straight Flush radar vehicle was seen on one of the many concrete stands around the range, where it is powered by mobile generators which are cleaner than the diesel and gas turbine units used originally.

[2] Deployed at an operationally realistic distance from its associated Straight Flush radar vehicle, this SA-6 launcher is equipped with mock-up Gainful missiles on a real chassis.

[3] One of the ZSU-23-4s was decorated with a red star for display at the nearby Haltwhistle Show, to remind the public of the vehicle's Russian origins. It was transported there and

back on a low-loader to prevent the caterpillar tracks damaging the local roads.

[4] The lower target acquisition antenna of the Straight Flush radar complex folds in the middle, and the entire assembly can be lowered to lie close to the bodywork in the travelling configuration.

[5] Military combat vehicles are not designed for comfort and the interior of the SA-8 self-propelled surface-to-air missile system is no exception. Although the vehicle itself is large, space for the operators is limited. Dominating the operator positions on the left-hand side of the vehicle (in the direction of travel) is the orange-tinted plan



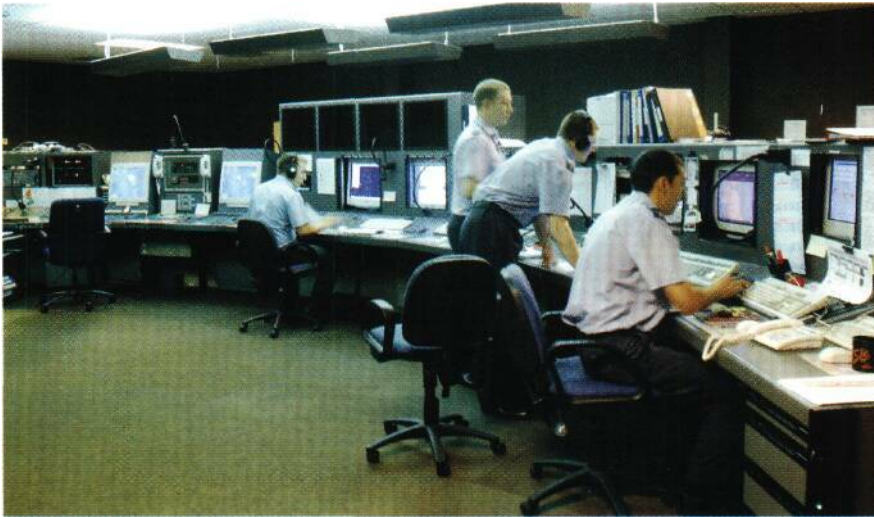
position indicator (PPI) and the TV screen used to supplement radar acquisition of targets.

[6] Spadeadam's terrain features are not unlike parts of Eastern Europe where this SA-8 system was first put into service, and it looks quite at home on the edge of the large Forestry Commission plantations which cover the site,

17J It is difficult to imagine going to war in the ZSU-23-4, which has the most cramped working conditions of any of the threat systems seen at Spadeadam. In addition to the limited space which creates a less-than-ideal working environment, there would be the noise of the cannons when the system is working 'in anger'.

[8] One of the transportable Low Blow emulators of the T1 threat system located alongside the operators' cabin, this assembly also looks very much like the original.

characteristics of the original radar complex of the SA-3 Goa missile system, this assembly also looks very much like the original.



An overall view of the Range Control Room, with the EW Threat Co-ordinator's position in the middle of the bank of screens and the booking clerks' and automatic meteorological station positions on the right of the picture.

When there is a missile launch, the pilot will try to lose the radar's track by jamming the radar with his electronic countermeasures systems. Noise jamming will disrupt the tracking, and the operator's screens will be blocked. This will cause the missile to miss the target, as it must be continuously updated with the target's range information in order to track the target. If the aircraft's jamming pod has picked up the radar's frequency, the operator will try to outwit the pilot by flicking a switch that will move the radar onto another frequency. If the jamming pod detects the new frequency, it will jam on this too, whereupon the operator will switch back to the original frequency, and the 'cat and mouse' game will continue. On a more sophisticated system, the radar would jump frequencies automatically. The SA-2 system, however, is fixed and does not have the luxury of frequency-hopping. Some six months of training is necessary before a technician/operator will be competent enough to get into the T-1 SA-3 simulator and run a mission. The advantage of the T-1, SA-6, SA-8 and ZSU-23 is that they are not computer-generated - the operator is actually pointing the radar. This is good training, because it shows up any mistakes made by the operator or pilot on the EW Threat Co-ordinator's report in Range Control.

The T-1's SA-2 system can track at 60 miles (96km), though the maximum engagement is 38 miles (61km), and at Spadeadam this could mean the target is close to Newcastle. The only countermeasures used against the threats are ECM, manoeuvring, and dropping in height for terrain masking, while chaff and flares are only used over the SPACES coastal site at Boulmer when there is an off-shore breeze. When chaff is dispensed, a big 'balloon' effect appears on the screen, resembling a cloud - the aircraft will actually be about three miles (5km) ahead of it.

Range Control

The Range Controller is Sgn Ldr Mike Cook, a retired career officer and ex-navigator. This post always goes to retired or current aircrew and provides a supervisory element to all the activities going on at the range. The Range Controller also ensures that the operators are putting the correct threats on the aircraft, as requested by the aircrew at the time of booking, and works closely with the Electronic Warfare Threat Co-ordinator (EWTCO). Other areas of

Range Control include a Semi Automatic Meteorological Station (SAMOS), usually manned by a booking clerk, though the EWTR also has some trained meteorological observers here. There is also a customised e-mail system for sending NOTAMs (Notice to Airmen), and a Windows-driven bookings computer which is part of the Spadeadam Integrated Command and Control System (SPICCS): bookings can be taken up to two or three years ahead. Jets are able to take a ten-minute slot, helicopters can take 30 minutes to an hour, and larger aircraft half-an-hour.

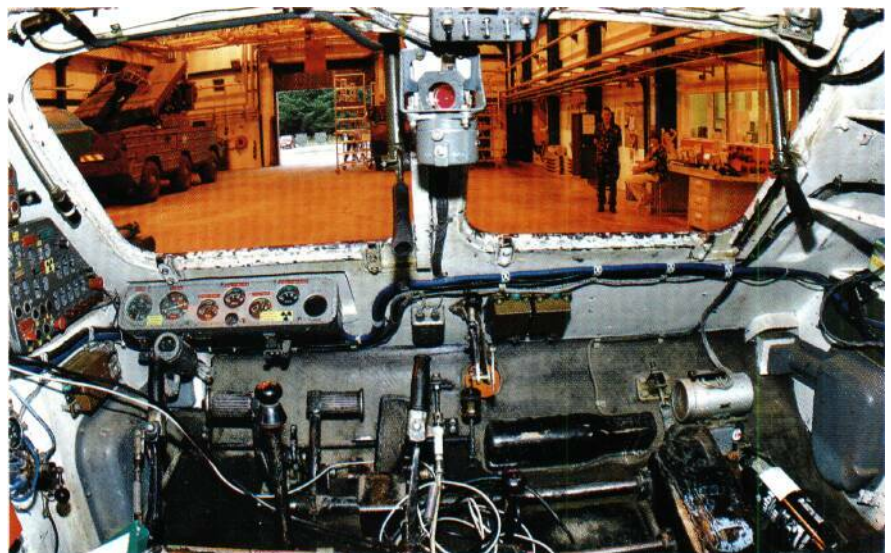
Range Control provides a daily flying programme. The Range Controller told *AFM*: "Each morning when the system is switched on, we decide what the required threats are after seeing the programme, make sure they are available and man up all the threat sites. The remote sites at Peterhill, Bells Crag, Bolts Law, Monkside, Lass Fell and Woodlow are not always manned, but are linked by a microwave system. The threat sites at Rainbow Hill, Berry Hill, R8 and Prior Lancey are all connected to here by fibre links or copper. This week we have a simulator at Bolts Law and Bells Crag feeding through the microwave links. The range also provides full air traffic control services, manned by up to three personnel - a Fit Lt and two flight

sergeants. They clear aircraft on to the range, the EWTR provides the threats and Range Control can provide a debrief of the information. Spadeadam does not physically debrief the crews, but only provides information on what the threat systems did. They debrief themselves".

The EW Threat Co-ordinator (EWTCO) is the link between the threats and the aircraft and can supervise the actions of both sides. Each aircrew requests threats, and can have single threats or double threats. The EWTCO is positioned beside a terminal from which he can pass information to and from the threat sites: basically he can overview all the different tracks. Two tracks in different colours are available on the screen - one telling him that a threat system is tracking the aircraft, the other advising him of a missile guidance signal. The latter indicates that a missile is going to be fired or a gun will simulate a firing (from ZSU-23-4). You can see the position of both aircraft on the screen, as well as the coloured tracks, and so gain a good idea of what is going on.

The EWTCO told *AFM*: "With four or five aircraft using the threats, and all the different threats active, you can get quite a few coloured tracks coming up on the screen. The actions of both the threats and aircraft are time-stamped so that personnel are aware of what is happening on the range. This is invaluable for the debriefing, as eventually you can see how many aircraft were using the range, and this can then be broken down to individual aircraft. You can find out when they were engaged, when they were tracked, locked up, if there was a missile guidance signal, if there was a missile firing, or if the aircraft broke lock (lost contact on radar). There is always a reason for breaking lock - the aircraft are either terrain masking (hiding behind hills or woodland features), making evasive manoeuvres, or dispensing chaff and other countermeasures. It is all input, and with this system there is a facility to video".

So no matter what tactical role is carried out by RAF aircraft - transport, bombing or combat air patrol - self-protection is a matter of concern for every aircrew member flying in what could be perceived as a hostile area. The invaluable instruction given at Spadeadam gives many of them the confidence to carry out their missions in the face of real danger.



A view from the rear of the operator's compartment of the SA-6's Straight Flush vehicle inside the CAFE hangar at Spadeadam, looking over the driver and vehicle commander's seats.