The Avionics Story: The Buccaneer S2, RN and RAF.

In August 1958, Ferranti Edinburgh received a copy of Specification No, R.R.E. X5434. This was issue 1 of a document that would define the Ministry of Aviation's requirements for the development of an Airborne Radar System Ref No. ARI 5930, i.e. Blue Parrot. By the time that this spec had risen to issue 3, dated September 1964, it realistically detailing the standard to be fitted to the S2 variant of the parent aircraft. The greater part of the original requirement still existed within this issue 3. We were now three years down the line from 700Z Sqn' s Intensive Flying Trials Unit evaluation of the S1 variant. The avionic changes that had taken place between issue 1 and 3, were more of the evolutionary type based on experience.
The changes beyond this time were borne out of increased flexibility in the Aircraft's Role, improvements in Navigation, Target Resolution, and to accommodate the advent of standoff weapons.

The bedrock parameters remained the same:
Tx Frequency: 8.925 to 8.995 Ghz. Magnetron CV2427
Local Oscillator frequency greater by 30 Mhz
Pulse length: 2 usecs
P.R.F. 316p.p.s.
Maximum Displayed and useful Range: 240 Nms.

The Radar to be integrated with the Mk 1 Strike Sight System, the Pulse Doppler Air Data System, ARI 5880, (Blue Jacket), the Master Reference Gyro and the Pilot's Head-up Display.
System Requirements:
(1) T.M.B. attacks against Blind and Visual Ship Targets and Visual attacks against Shore Targets.
(2) Dive Bomb and Rocket attacks, Blind and Visual, against Ship Targets, and Visual against Shore Targets.

(3) Anti-Ship search
(4) Mine Laying
(5) Assist parent aircraft to locate refuelling Tanker Aircraft.

Equipment Operation Modes:

(1) Search and Navigation.

Cover an area of sea or land, +/- 50 degs about aircraft centreline, scan speed of 1 rad/sec, at an Elevation angle selected by the Observer. Received signals to be displayed on a CRT, in order that the Observer can move the Bearing and Range Markers over the Target. The Transmitter can then be switched to Off, the Aircraft can then descend to a low altitude, whilst the Target maker is maintained as Ground Stabilised by virtue of outputs fed from the ARI 5880 Air Data Doppler Radar and the Gyro Compass to the Radar set.

Offset facilities will be required in order to mark a Target, in Range and Bearing, from a known radar Target. This for both Attack and Navigation purposes.

(2) Acquisition.

This will take the form of a Narrow Angle Scan (+/-10 Degs) about the Bearing Maker, which will be used (a) prior to "Lock", and (b) to track a Target that may not be sufficiently discrete to allow "Lock" to fully function.

(3) Lock,

This facility will allow any discrete Target, that the Observer has marked, to be auto-followed in Range, Bearing and Elevation.

(4) Radar Ranging.

This Aerial will be controlled in such a manner, that it will have a response to airframe movement as that of the Aiming Mark displayed on the Pilot's Head-up Display. The Pilot, will visually place the Aiming Mark over the Target area, thus providing Range information.

If the Target *is* sufficiently discrete, it should "Lock-on" to the Target to give continuous Range information.

(5) Terrain Warning.

The Ariel will be held at a fixed angle of 3 Degs Depression to the flight line. Reflected signals from the ground will be fed to the ranging circuits, which will close a relay to complete an external warning to the Pilot of high ground ahead. (This role was never fully cleared, nor accepted for Sqn use, but remain in for the duration of the Radar's service life)

(6) Roll axis.

At least +/- 90 Degs.

The values provided in reality were + 90 - 270 degs.

(7) Elevation axis.

+10 Degs, - 30 Degs, relative to the Roll axis.

(8) Stabilisation.

The accuracy of stabilisation will be better than +/-1 Deg within 2 seconds of steady flight condition being attained.

(9) Elevation Control.

The +10 Degs to - 30 Degs will be controlled from the Hand controller. A fixed depression will also be provided with a value of - 2.5 Degs when either of the two longer Ranges is selected, and 1 Deg when any of the shorter Ranges are selected. A facility will be provided that will raise the aerial elevation by 0.5 of Beamwidth for a half scan, returning to original angle for return half of the scan, i.e. a 2-bar scan pattern.

(10) Receiver Noise figure.

This shall be better than 11.5db.

The parameters detail in the previous pages, are a selection of the basic elements that defined Blue Parrot.

The system owed a great deal to AI23, the Genesis of Ferranti Edinburgh Airborne Radar systems, with system being the operative word. AI23 was first the Monopulse Tracking Radar to enter service anywhere in the world. The Aerial, the RF Block, with the 3 outputs, Sum plus Azimuth and Elevation Difference channels, the "Lock" circuits and the Transmitter would form the backbone of the Blue Parrot design. These elements and the decision to stick with X-Band were the main building blocks for what would define this Blue Water Radar.

The principle requirement of the Buccaneer was to find and neutralise the Russian Heavy Cruiser threat. With the aircraft's predicted ceiling at 35,000 ft, thus, by definition, giving a nominal maximum range to the earth's surface of 240 Nms, would set the Pulse Repetition Frequency at a nominal 316 p.p.s. The rest followed from that in terms of Transmitted mean power, Receiver sensitivity etc. 700Z Sqn's Intensive Flying Trials, verified the performance of the system in terms of Maximum useful range.

With the advent of the S 2 version of the Aircraft, in the mid '60s, and the results of 700 B Flight's Intensive Flying Trial work, there would be a follow an evolution of changes, modifications that would continue right up until the mid to Iate1980's.

The early S1 experience had shown that there was a need for a more in-depth 2nd Line servicing particularly with carrier operation in mind. The introduction of the Monitor Test Set Radar and the Screen RAM Nose at 1st line, gave a facility to test the basic radar parameters, including being able to Transmit, with the Radar in the Aircraft, whilst still on board ship.

A.C.M.

An Anti Counter Measure, was introduced that allowed the Radar to maintain "Lock" in the presence of a Jammer By operating the ACM switch on the Control Radar Set, a system was employed that eliminated the Range element of the Lock function and allowed the Scanner to maintain Bearing on the Target by auto following the Jamming source.

A New Aerial Design.

The original design of the Aerial, had been based upon that of AI23, i.e. double parabolic style. In the mid 60's a new aerial, based on the Cassegrain principle, was introduced. The bi-directional capability of the Aerial was achieved by virtue of a polarisation shift of 45 degs in the reflector section of the Aerial. The design and development work, carried out by the Ferranti Edinburgh Aerial section since 1959, provided a main beam with lower side lobes, and a higher overall Gain, among other virtues, thus providing superior coverage of the sea in the long range search mode.

An element of countermeasures had already been introduced, that "parked" the Aerial in the hard to Starboard position when the set was not on "Transmit". This was considered to reduce the effective head-on reflection area of the Aircraft. Certainly 700 B found this to be the case against an "S" Band Radar. A Push Button switch was fitted to the Observer's Control Indicator, in order that the aerial scanning system could be confirmed prior to flight and when not transmitting.

M.R.E.

The next change was the introduction of Monopulse Resolution Enhancement, or MRE. This required a significant redesign of the 3 Channel IF Amplifier, that had previously only used during the "Lock" phase.

This Amplifier, operating on a Linear Law, accepted the 30Mhz IF signals from the Sum, Azimuth and Elevation Head Amplifiers situated on the RF Block. These 3 signals, suitably phased and amplified, would normally have provided video level outputs to drive the Scanner servos in order to maintain directional Lock on a discrete Target. MRE would utilise the Azimuth signal to modulate the Sum signal, which would in turn provide a Target Bright up on the Observer's Display.

To describe the operation of MRE, one must visualise the scanner traversing a Target, say from Port to Starboard. As the scanner traverses, the Starboard element of the Azimuth lobe paints the Target first. This results in a - ve signal at video level, this level would diminish to a null as the Scanner traversed to Target centre. Once through the centre, the Port element of the Azimuth lobe would now begin to rise from a null to provide a + ve signal at video level. Modulating the Sum Signal provided the Target resolution, i.e. the paint up on the Display from the Sum Signal would only appear when the Azimuth difference signal was less than a set +/- video level of 1.5 Vdc. To provide this facility, the last two amplification stages of the Azimuth Channel were transistorised and gain controlled by a separate "Sharpness" control. This control being fitted to the Indicator Azimuth and Range, i.e. the Observer's Display.

There was however a situation, re Target separation in arc, that had to be appreciated by the Observer. If two Targets were on a similar Range arc, but are not separated in Azimuth by more than the Scanner Beam width, then a false Target could be painted between two genuine Targets. However without MRE these two Targets would paint up as one continuous Target. Where MRE made a significant unambiguous difference, was in the definition of coastline.

Another aspect of its use was realised later in service. Since MRE Video was sourced from a Linear Amplifier, the strength of return, as a paint-up on the Display, was in direct proportion to the strength of signal received and therefore an indication of the reflective area of the Target. Therefore by selecting MRE Video after Target detection, by the Video logarithmic Amplifier, the Observer/Navigator could reduce the Manual Gain until there was only one Target showing i.e. the largest and more than probably the prime Target.

The Target Marker Computer. This was the one major assembly, within the Radar, that gave the greatest proportion of problems. This unit was primarily responsible for the provision of the Ground Stabilisation of Targets. Taking as it did, inputs from the Blue Jacket and the Gyro Compass; it was not always glaringly evident as to how and where errors and inaccuracies should be apportioned. It also controlled the inputs from the Control Radar Set that positioned the Range and Bearing Markers on the Display, and in a similar way, the Offsets Control. There was probably some irony in that Chapter 13 in the Bay Servicing Schedule covered the calibration of this unit.

There were a number of modifications carried out on this unit, including the introduction of solid-state subassemblies where and whenever possible. Probably the mention of Co-ordinate Converters, and Northings and Eastings Integrators will no doubt ring a few memories for some. As part of a range of associated Modifications to improve the Target Data accuracy within the TMC, a short Range Offset system was introduced into the Control Indicator. Originally there was only one Offset control that covered all the way from 0 to 240 Nms. With the Aircraft now entering into dual Service, the overland role would now become a major aspect.

The Offsets Mode was intended to give accurate positional data for a Target that perhaps could not be considered as discrete. If, however, that Target was known to be close to a reference Target that was discrete and could be illuminated, the Offset Control on the Control Indicator could be used to generate the appropriate Offset Bearing and Range, from the discrete Target to the non-discrete Target. Since it was accepted that most attack mode offset work would be well with the 240 Nm Range, a second Short Range Offset Control, covering 0 to 29.9 Nms, was introduced into the Control Indicator. The principle now would be that the Long Range control would cover Navigation requirements mainly from the use of Identification Points, i.e. the IP. Mode. The Short Range control would be used in the Attack Mode where an Offset from a known discrete Target position would be pre-set. Once the discrete Target position had been marked, the Observer/Navigator would then switch the Offsets mode in. This would result in the Displayed Range and Bearing Markers being transferred to show the position of the non-discrete Target, and allow the Attack phase to continue. The accuracies values for both Ranges were established from Ground Trials carried out at Holme on Spalding Moor. With perfect synthetic inputs replicating both the Blue Jacket and the Master Reference Gyro, the Short Range Offset data was within 600 ft and the Long Range within 1% of offset Range.

The Martel Missile.

The basic requirement for the Martel was a Target Bearing relative to Aircraft Track, as against Aircraft Centreline. To provide this a modification was carried out within a subassembly of the TMC. The unit in question, the Co-ordinate Conversion Servo Mechanism, normally maintained the Target Bearing angle to Aircraft Centreline.

To provide the Martel requirement a Control Differential Synchro was added to the subassembly, which provided, when required, an output Target Heading relative to Aircraft Centreline +/- Drift Angle. One interesting aspect re the Martel was that Ferranti supplied the Manufacturer with Magnetic Clutches that were originally designed to drive the Scanner of the Forward Looking Radar (FLR) for the TSR2. Perhaps the only bit of TSR2 that flew in Service?

Ground Position Indicator Corrector Unit. (GPIC) The Buccaneers first participation in the Red Flag Competition in Nevada, showed that it could more than hold its own, nothing being able to live with it at low level. The only fly in the ointment was the Navigation, in particular finding the right co-ordinates for the nominated exit gate from the exercise area. The quest to remedy this shortcoming brought the RAF at Laarbruch into direct contact with Ferranti Edinburgh, and in particular with the Product Support Dept, then based at Robertson Avenue. Under the Technical Management of the late Bob Purves, a project was started to produce a Corrector unit for the Ground Position Indicator. This would entail the first military use of the Motorola 6800 eight-bit microprocessor. To describe fully, the work and development that went into this unit is probably worth a book in its own right. The unit became known as the GPIC (pronounced jipic) to both Service and civvies alike. It had five main modes of operation known under the acronym of C.A.N.I.T.

(1) Correction.

The principle aim of the GPIC, to update and correct the G.P.I, by means of the visual overfly facility or by offset from the placing of the Range and Bearing Markers over a Target return with known co-ordinates.

(2) Attack Mode.

Attack Mode using Strike Sight, with the GPIC determining offsets on the Indicator Azimuth and Range (I.A.R.).

(3) Navigation Mode.
A target position, in Lat/Long or Grid, derived from the GPIC, could be displayed, by a Range and Bearing Marker, on the I.A.R. on all ranges, for Navigational purposes.

(4) Interrogation Mode.
With the Radar Transmitter on, any Target shown on the I.A.R. could be marked by using the Lat and Long paddle switches on the GPIC. The co-ordinates of the Target in question could be read from the GPIC Display.

(5) Target of Opportunity.
Targets from the Interrogation Mode or by use of the Overfly facility, could be stored as waypoints or as targets of interest to be revisited.

All the Flight Trials of this unit were carried out by the RAF rather that A&A.E.E. This was a decision based both on a financial basis and the RAF personnel involved with the Aircraft at that time. One of the first trials involved a Buccaneer leaving Laarbruch with a Target of Flamborough Head Lighthouse. A chase aircraft in the form of a Phantom, fitted with a Litton Inertial Navigation system, was used as a reference marker. Both aircraft would navigate by virtue of their respective Nav System and follow the steering data on the head-up Display. The Buccaneer crossed the UK coast some 1 Nm from the Target, whilst the Phantom was somewhat further adrift. The Phantom system was reset up by B.Ae and a return journey undertaken. The Buccaneer returned by flying straight along the centre of the runway in Germany, whilst the Phantom was some 2 Nms out. The trials proved that the GPIC had brought the Buccaneer navigation capability up to that of at least the first generation Inertial Nav System. The unit itself was fitted in the rear cockpit, in a position previously occupied by the Passive Warning Receiver.

Its inclusion meant that both the Long and Short Range Offset controls could be removed from the Control Indicator. In the space vacated, a Planned/Direct selector switch was fitted.

The GPIC had a Built In Test (BIT) facility, selected by rotating the thumbwheel selector to position "0", then, by pressing the "Overfly" button, the tests would commence. There was also a built in 2 stage contingency to cover possible system failure. By selecting the GPIC "In/Out" button to "Out", the data flow from the Blue Jacket to the GPI, would only be passed through the A to D and D to A converters without any processing. The second option was to use the "Deselect" switch, by putting this in the Deselect position, the GPIC acted only as a Junction Box for the GPI to Blue Jacket wiring. In reality the reliability of the GPIC was a revelation, with only the occasional failure of a 7-segment pinlite, and a minor silver migration problem with capacitors in the Power Supply S/A to blot the copybook.
To store a planned flight programme the Navigator would make pre flight notes of the Lat/Long co-ordinates of the end of the Runway in use, and a further up to seven waypoints, on the intended sortie route. Once in the aircraft, the GPIC thumb wheel would be turned to position (1) after self-test had been run on Position (0). The Runway co-ordinates would now be entered using the Fast, Medium, Slow paddle switches; this setting would automatically be entered into all switch settings up to Position (9). Turning to Position (2) the co-ordinates for Waypoint 1 would be entered by updating from that entered in (1). Turning to Position (3) the next co-ordinates for waypoint 2, would be entered by updating from those entered in (1), and so on up to Position (8).
Position (9) would be left as a store for any Target of opportunity.

On Take-off, the Navigator would have Position (1) selected and as the aircraft passed over the end of the Runway he would press the Overfly Button to correct the GPI, and then select (2) to provide navigation info to the first waypoint.

When the Buccaneer returned to Red Flag with GPIC fitted, the Aircraft proved virtually unstoppable. The situation being tragically marred by the unfortunate deaths of an aircrew in a low flying accident.

I was reliably informed that prior to the accident, the Radar Bay techs had made just a little money by allowing their American counterparts to view a real "Tube" Radar set.

The Final Update: ASR 1012 Austere Package. The reason I refer to this as the, austere package, is that a significant amount of the Ferranti Radar, as distinct from the Ferranti Inertial Navigation input, did not make it through to inclusion. This was due to the financial constraints placed upon BAe by the M.o.D. I feel sure that every Navigator who flew an updated Buccaneer would have been most appreciative to have the Pavespike Display removed from between his knees. A Digital Scan Converter was designed and demonstrated to the M.o.D/ BAe and the RAF on a cold January Day amid heavy falling snow, from the eerie that was the North Glassmount Farm Trials hut above Burntisland in Fife. It would have been a multi-function display to cover Radar, Martel, and Pavespike Laser Designator Video.

From the possible to the actual, the main purpose of the ASR, was to make the Aircraft Avionics suitable to match the Sea Eagle Missile. Earlier trials, held a Lossiemouth, showed very clearly that the TMC was not up to the job, being only capable of maintaining the required accuracies for no more than 5 Flying Hours. The next aspect being that the Blue Jacket was to be replaced by the Ferranti digital Inertial Nav System, designated the FIN 1063.

This meant that the Parrot would now have to send info to, and receive info from, a digital device. Most of the aspects originally covered by the TMC were now to be taken over by the FIN; therefore the TMC would be made redundant. (Sighs of relief from Lossie could be heard in Edinburgh) To maintain such aspects as the Centre of Gravity and overall weight of the Radar Set, the item that would take the TMC's place had to be of the same fit, weight and C.of G. This Radar Interface Unit, as it became known, was primarily a bi directional A/D, D/A Converter. However there were other factors worked into the unit such as the speed of the Range marker over the IAR Display with different Ranges selected. The intention being that the two rates selected by the Hand Control would result in the same rate across the screen, whether it be 30 or 180 Nms for example, selected.

The prime requirements for the Sea Eagle are accurate Range and Bearing, both these parameters came from the Radar set to be converted to a digital format by the new Radar Interface Unit. The Bearing accuracy required could not be met by the existing Azimuth angle synchro, which had to be replaced by a modern device that would be less "noisy" and would be compatible with a Synchro to Dig converter.

The final package, despite some omissions, was a quantum leap in avionics terms for the Buccaneer.

Other changes within the Radar were the alteration to the Ranges viewed in "B" Scan from the Expand selection control on the IAR. These were as follows: 30 to 90, 80 to 140, and 130 to 190 Nms, aimed at or around the Sea Eagle areas of interest.

Along with changes to the Parrot etc, a new Radio Altimeter was fitted with a rear cockpit repeater fitted in the Control Indicator, where once lived the original Offset Controls.

At the heart of this update, and the major component was the FIN 1063. Apart from making the TMC redundant, this system represented the centrepiece of the avionics system. Like GPIC, the FIN could have a whole book of its own.

For Sea Eagle, it had a serial data system, buffer connected to all four wing pylons, providing eleven dedicated Tag Words that supplied pre release data to the Missile. These being, Target Range, Bearing, Aircraft Roll Angle, Elevation Angle, Mach No., Altitude, True Heading, Wind Speed, Wind Direction, Outside Air Temperature, and Time from Fix. (This is the time from the last Nav update by Radar)

For Strike Sight it supplied Ground Speed, Range to next waypoint or Target, and Steering Angle, to provide target spot azimuth deflection for the Head-up Display.

For the Radar, the FIN supplied a similar set of inputs to that sent to the Sea Eagle. Target Bearing was sent as two separate inputs, one to provide the Bearing line on the Indicator Az and Range, the other to act as a central bearing reference for the +/-10 Deg Narrow Angle Scan, if, as and when the Radar was used to locate the Target. Target Range, this was used to position the Range marker on the Indicator Az and Range to update the Navigator, and a System Status signal that was used in the Ground Test facility. All these signals were buffered through the Radar Interface Unit All these facilities were replicated in an R.I.U. Test Set that was fitted into the 2nd Line Test Stand.

The FIN also interfaced with a new Radio Altimeter, this unit was the first choice of altitude data to the Sea Eagle, the first fallback being Baro Height. The Rad/alt also had an option where min/max limits could be pre-set, if the Aircraft deviated from within these limits a set of "Traffic Lights" would warn or advise. Green indicated aircraft was within limits, Amber indicated, aircraft above Max, and Red, aircraft below Min.

A rear cockpit repeater indicator was fitted in the Control Indicator, in a position previously occupied by the Target Offset Controls.
A new Plessey "secure speech" radio was also included in the package, but under a separate ASR. This last item produce a inter system interference problem between the Parrot, on transmit, and the Radio with the squelch lifted. The aircrew normally set the Radio to listen to Channel plus Guard with the option of squelch inhibited. The result was that whenever the Radar was set to transmit, the aircrew were aware of interference coming through the Radio.

Although Ferranti solved this problem by virtually enclosing the Transmitter assembly in a Faraday cage, the RAF eventually decided to live with the problem since Radar Tx periods would be kept to a minimum.

Sufficient to say that the abilities of the Fin 1063 surpassed anything else in RAF service at that time, and since it may still be fitted to some other aircraft as we speak; I'm a bit reluctant to go too far in extolling its virtues. Over the period of the Development and Production period of the Update to Blue Parrot, Ferranti South Gyle received some 60 odd Radars. The first six were used as A and B models all the way up to Flight Trial level. The remainder came arrived in a phased programme to be modified and to a great extent refurbished, The modification programme was carried out by the Production Dept along with some level of Test. The final Test and Calibration was carried out by ourselves in the Lab prior to dispatch to BAe Woodford. During this period we found several aspects of the setting up procedures could be improved, mainly by virtue of the then state of the art of commercial test gear that was not available some 20 or so years previous. The result of this was that aspects such as overall Noise Figure could be reduced to less than 9db. With full power output from the Magnetron, matched pairs of detector diodes in the Balanced Mixers, a calibrated Radar was more than capable of detecting commercial aircraft to well in excess of 10ONms. Our Lab Radar window was some 30ft above ground level, facing due North from Edinburgh. This gave us a "view" of the commercial "Over the Pole" Transatlantic route, Targets of Opportunity you might say, not too bad for an old Valve Set. As a result of all this work, the RAF received a set of almost "new" pieces of kit. Subsequent Liaison visits to Lossie revealed that the majority of the Parrots remained in Aircraft for 5 to 6 months or more. The only subsequent modification after the Update was to the Control Antenna Sub Assy. During a liaison visit, I was asked to look at a problem with a Radar set that had just been removed from one of the OCU Aircraft. The Radar set was permanently selecting Terrain Warning whenever it was switched on. The fault was initially traced to a jammed Ledex Selector Switch in the Control Antenna S/A. However a secondary fault was detected in the new Radar Interface Unit, which showed a trace line of overheating on the Multi Layer Motherboard. The upshot was that the Ledex being a solenoid operated, which if jammed, results in a continuous high current to flow instead of the short duration 0.5 seconds as normal. If the Range Marker on the Radar is placed beyond 30Nms, and the Scanner phase changed from Narrow Angle, the Control Antenna Ledex receives a 28 V signal from the RIU to skip the selector passed to Lock or Track phase, to bring the Scanner back to Search. Because the Ledex jammed before reaching the Search position, the high value of current had proved too much for the PCB Track material. The result was an S.T.I. (Services Technical Instruction) to fit an intermediate Relay in the Control Antenna S/A, thereby ensuring that the Motherboard Track would never see a higher current than that of a Clare Crystal Can Relay, the last Blue Parrot change.

The combination with the Long Range detection capabilities of the Parrot to provide targets, and the FIN to store them, you had more than probably the best DIY Maritime Strike Aircraft in the world at that point in time. In other words it could find and deal with its own trade, being reasonably independent of AWACS etc. When the Buccaneer went to the Gulf in its Laser Designating Role using the Pavespike, had this call come a little later in life, the Navigators life may well have been a little easier. The FIN 1063 team had developed a scheme that would have been able to hold the Designator Head in a Ground Stabilised manner which would have relieved the Navigator of the chore of "flying" the Laser Head, at the same time as guiding the pilot to keep the parent aircraft within the confines of the Designator head gimbals.

Strike Sight.

This system started of, as you would expect, as Mk1, it would eventually finish as Mk 5. Most of the changes that took place were in conjunction with improving accuracy and providing ballistic solutions to various types of Bomb. The system was one of the first "solid state", but still analogue that Ferranti designed. The attack options were gradually reduced as time marched on, such approaches as Over the Shoulder quickly became a virtual suicide mission. The Dive toss and Medium Toss were the next to go and with the advent of the Stand-off Missile the only mode that survived to the end was the Long Toss. Even this was considered as a last resort, however had there been any further Tornado losses in the 1st Gulf War during the Runway Denial period, thoughts were turning to Long Toss. Being able to throw a 1000lb Bomb from three miles away suddenly seemed attractive once again. The development of Strike Sight owed a great deal to Lt. Commander Pete Walwyn and Ferranti chaps such as John Steadman and Joe Dickie, to name but a few.

The Test Equipment side of the Project was initially only intended to have one 1st and one 2nd Line Test Set. Every 1st line Test Set was weather sealed in a cast aluminium box with "scupper holes" so that any water that might land on it would drain away. Each of the units was put through a dunking test to ensure that it was watertight. As time went on, the number of Test Sets increased each affectionately know by its acronym, therefore the Switching and Patch Unit would be a SPU, the Gyro Unit Test Stand as a GUTS, the External Simulator as an EXSU, the Internal Simulator as an INSU etc. Someone attending a PDS Meeting on Strike Sight Test Gear for the first time might just wonder. Included in this enlargement of the Test Gear inventory was a Test Unit dedicated to the Weapon Systems Performance System (referred to as Whispers). An alignment Fixture was also introduced called the Periscope Strike Sight Alignment Jig. This unit was designed to fit onto the three alignment spigots that located the Nose Section of the Aircraft when it was brought back into line. It carried two Collimators, the upper was used to align the Head-Up Display the Aircraft Centreline, and the lower to align the Strike Sight Gyro Unit. The Head-Up Display or Pilots Display Unit, as it was originally called, was controlled in terms of display format, by a Waveform Generator. Both these units were the responsibility of Rank Cintel. The Generator also provided a similar facility for the Weapon Systems Performance Recorder.

With regard to earlier events such as the Bombing Trials by 700 B etc, I must admit I had a great deal of sympathy for the man in the back seat, with regard to any inaccurate deliveries.
The Control Indicator housed a number of Strike Sight input control parameters, in the form of: Target Course, Target Speed, Wind Speed and Direction.

These were important factors in the accuracy of delivery, along with the ability to produce an accurate figure for Speed over the Ground.

In the case of fixed Targets on Ranges, such as Tain or West Freugh, the Target Speed and Course are effectively eliminated from the equation. However wind speed and direction, although advised from Ground Level, are indeed not always the same as that experienced at the Aircraft.

Some work carried out by mathematicians at Ferranti, produced a graphic representation of potential errors due to wind strength and direction. Range errors could occur if Airspeed was significantly either greater or less that True Speed over the ground, i.e. flying directly into or with the Wind. For a system that was originally designed to toss a nuclear depth charge into the midst of an enemy convoy and hopefully escape, it did pretty well to control anything from 25 to 1000 Ib iron Bombs as well.

But that's all in the past now, sufficient to say that the MK 5 version of the Control and Release Computer, coupled with the FIN 1063, and the improved Blue Parrot would have stood the test, if required. The only thing that could have replaced a Buccaneer was another Buccaneer. I often wonder what would have happened had the 2STR project gone ahead after the cancellation of the TSR 2.

A Buccaneer with the TSR 2 avionics, Terrain Following down to 50 ft height clearance in all weathers, Multi Function Display, Inertial Nav system etc, the stuff of dreams. The Bucc, after all, had carried out the bulk of the Terrain Following Trials, some 350 Hrs or so that was well and truly a proven combination.

Blue Parrot was also fitted to the MK 22 Canberra, being used as an Observer Training Facility and an assessor of ships ECM capabilities.

Alex W Duncan.