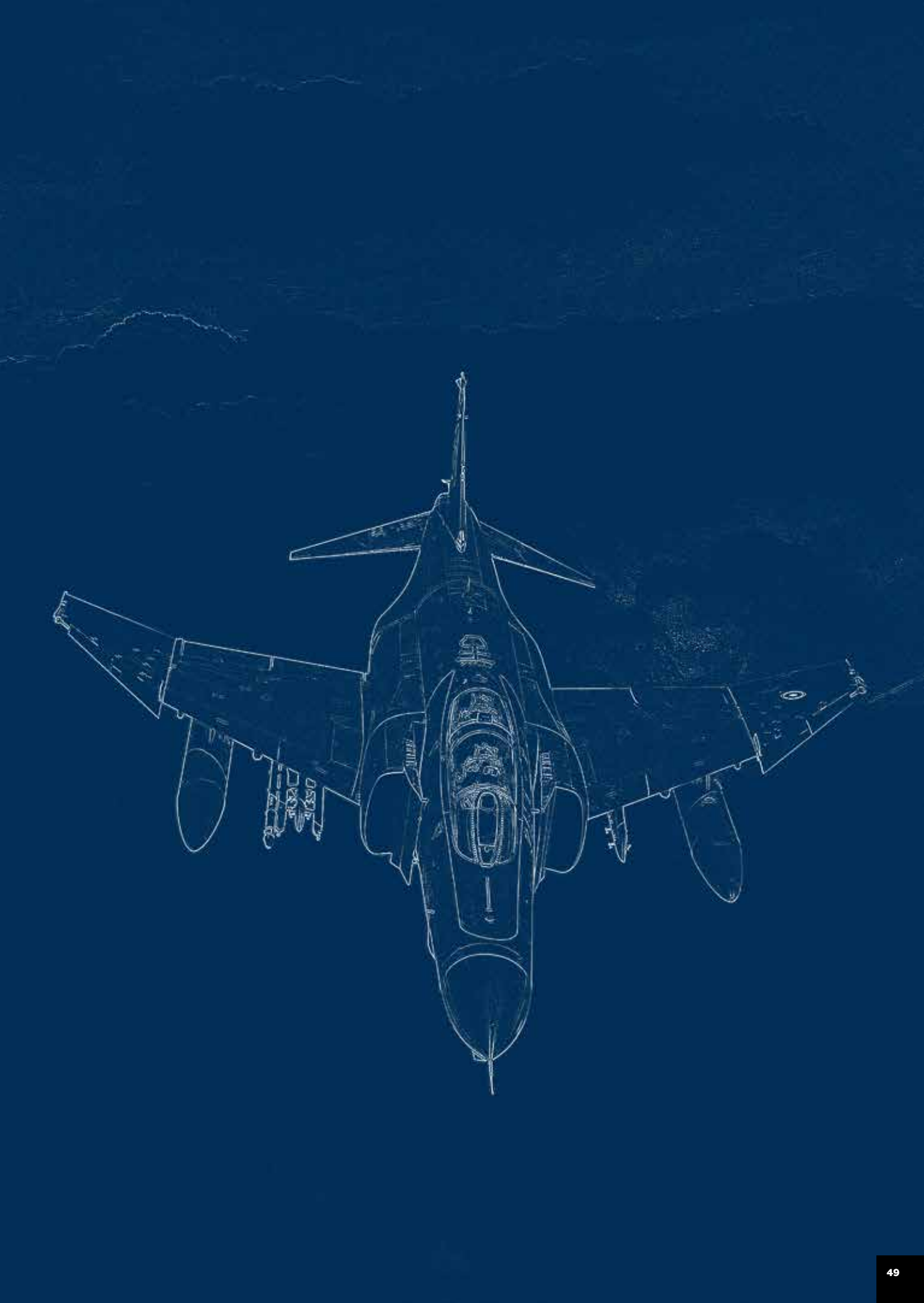
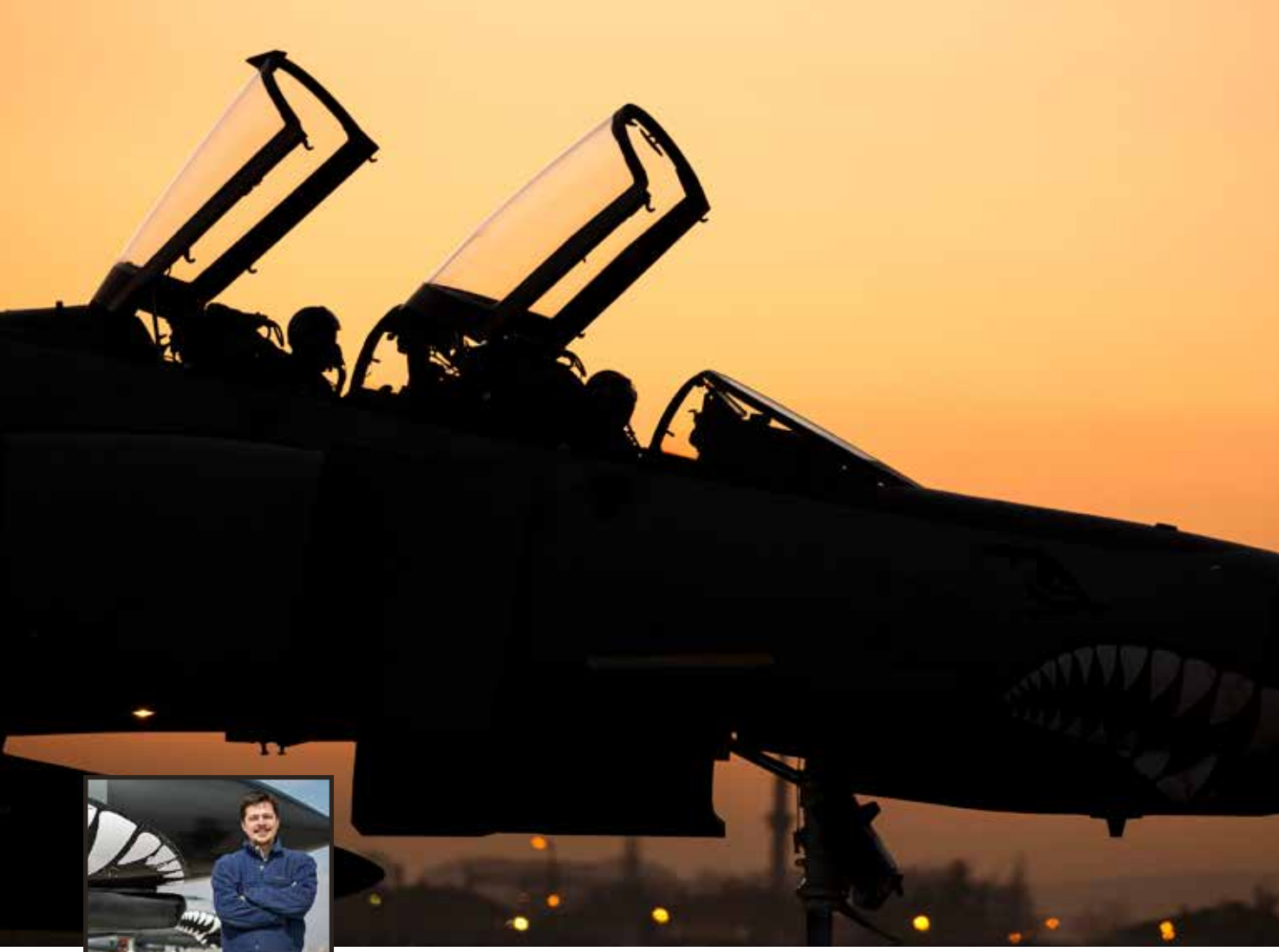
F-4 phantom II

FLIGHT ROUTE IN TURKEY AND WORLD





by Cem DOĞUT

Phantom's story began in 1952 when David S. Lewis was appointed as the preliminary design manager of McDonnell Douglas (MDD). With the team he established, he started working on the new aircraft model requested by the U.S. Navy. The aircraft would be a supersonic fighter jet. MDD started the "Super Demon" project based on the existing F3H Demon model. MDD's rivals the Grumman XF9F-9 and the Vought XF8U-1 Crusader were already meeting the supersonic fighter requirements. In response, they started to work on the more advanced YAH-1 project in 1954. The planned design criteria were a single-seat fighter/bomber that could operate in any weather conditions (all-weather). The project was launched with these needs, but on May 29, 1955, new requirements were sent to the company by the Navy. Everything had changed suddenly. Now, the Navy wanted a tandem-seat fighter jet that could fly CAP (Combat Air Patrol) missions at 300 miles for 2 hours with the capability to detect and engage hostile aircraft at extended ranges.

The YAH-1 project was later revised. A second crewman was added to operate the radar, the internally mounted cannon was removed, the fuselage was modified to carry four semi-active homing missiles, and the General Electric J79-GE-8 engine was selected to power the aircraft. The J79 was also used on the McDonnell Douglas F-101 Voodoo aircraft, and as in Voodoo, the engines sat low in the fuselage to maximize internal fuel capacity and ingested air through fixed geometry intakes. With all these changes, the first XF4H-1 prototype was finished and became ready for new trials. On July 25, 1955, the Navy ordered two XF4H-1 test aircraft and five YF4H-1 pre-production examples. The first test aircraft made its maiden flight on May 27, 1958, with test pilot Robert C. Little at the controls. The plane was officially named Phantom II on July 3, 1959, at the 20th anniversary of the factory to honor FH-1 Phantom, the first jet aircraft produced by McDonnell Douglas. The F4H-1 first entered service in 1960 with the U.S. Navy. In the meantime, the United States Air Force also requested a new plane. Secretary of Defense Robert McNamara wanted the same aircraft to be used in all aviation branches (Air Force, Navy, Marines) of the military. The Navy wanted the Phantom as an interceptor, while the Air Force wanted it for its fighter-bomber missions. The new Phantoms produced for the Navy are considered more successful than the Convair F-106 aircraft used by the Air Force and was selected by the USAF as well. The plane was initially designated F4H (later F-4A) by the United States

Navy, while the original designation by the USAF was the F-110A Spectre (later F-4C). The F-4 designation came about in 1962 when the designation systems for all branches of the U.S. military were unified by order of U.S. Defense Secretary Robert McNamara. The first Air Force F-4C Phantom flew on May 27, 1963, exceeding Mach 2 on its maiden flight.

The first Phantom model used by the Navy in real terms was the F-4B. In 1961 both the Navy and Marine Corps began to add F-4Bs to their inventories. The aircraft is equipped with J79-GE-8 axial-flow turbojet engines, AN/APQ-72 radar, AAA-4 infrared search & track (IRST) system, and AN/AJB-3 bombing computer. A total of 649 F-4Bs were produced. In the following years, this model began to be replaced with the F-4J, and between 1966 and 1972, 552 F-4J aircraft were delivered in total. The 288 F-4B aircraft were upgraded to the F-4N standard.

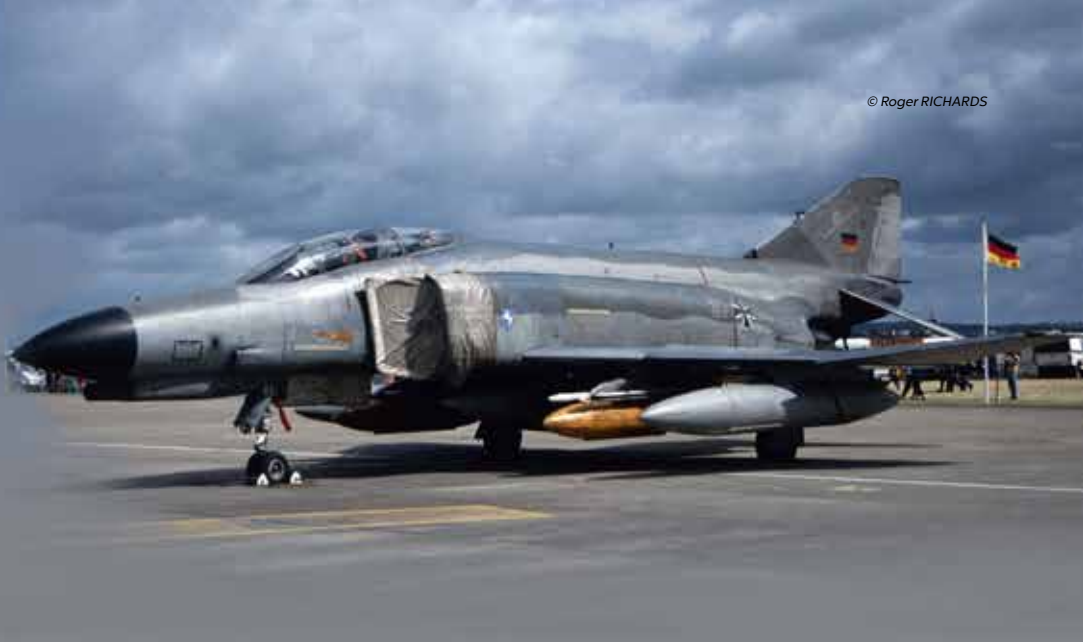
The F-4B Phantom II aircraft went to Vietnam on August 5, 1964, to conduct bomber escort missions. On April 9, 1965, the Phantom II won its first air victory. During the war, U.S. Navy F-4 Phantom squadrons participated in 84 combat tours with F-4Bs, F-4Js, and F-4Ns. The Navy claimed 40 air-to-air victories at the cost of 73 Phantoms lost in combat (7 to enemy aircraft, 13 to SAMs, and 53 to AAA). In 1987 the last Phantoms were retired from deployable USN squadrons. Phantoms continued to serve as target drones (QF-4) at the Naval Air Warfare Center until their subsequent retirement in 2004.

The Air Force F-4Cs arrived in Vietnam in December 1964. On July 10, 1965, F-4Cs of the 45th Tactical Fighter Squadron scored the USAF's first victories against North Vietnamese MiG-17s using AIM-9 Sidewinder air-to-air missiles. In 1962, the U.S. Air Force wanted to replace its RF-101 reconnaissance aircraft and started the RF-4C development program. The prototypes were concerted from the existing F-4C airframes, and the production aircraft made its initial flight in May 1964. The nose section was redesigned and extended by 33 inches, and the AN/APQ-116 terrain-following radar (TFR) was installed on the aircraft. For photography, the plane was equipped with a KS-87 forward oblique camera, two KS-87 side-looking cameras, and a KS-56 panoramic camera pointing straight down. The aircraft's sensor suite was also upgraded with the AN/APQ-102 side-looking radar and the AN/AAS-18A infrared reconnaissance system for easier navigation in adverse weather conditions and night missions. In 1971, the RF-4E was produced by combining the RF-4C nose and the F-4E airframe for the German Air Force. The RF-4E was the unarmed export version offered to allied air forces. It was designed strictly for export and never served with the USAF.

The F-4D model was put into service in 1967. Although the F-4C was virtually identical to the Navy/Marine Corps F-4B in performance, the F-4Ds were explicitly tailored for the needs of the USAF. The D models were later upgraded using the experience gained in Vietnam. They were integrated with a new optical sight and lead-computing gunsight. The aircraft could carry 20mm SUU-16/A and SUU-23/A external gun pods. Also, they started to use laser-guided munition for the first time with the AN/AVQ-10 Pave Knife targeting pod.

In the late 50s and early 60s, the U.S. Air Force thought that the era of close-range dog fights with aircraft guns was over. This because the USAF believed that newly introduced radars and air-to-air missiles would replace the cannons, and the hostile aircraft would be engaged at 10-15 miles without getting closer to the enemy. Phantom II was built on this theory. Unfortunately, this theory soon found to be a mistake, and USAF learned the hard way in the Vietnam War. The relatively new heat-seeking and radar-guided missiles at the time were frequently reported as unreliable, so the cannon was still needed for close engagements. To overcome this problem, USAF F-4Cs began carrying external gun pods; however, the desired hit rate could not be achieved as the aircraft was not equipped with lead-computing gunsights. The lack of a cannon was addressed by adding an internally mounted 20 mm M61A1 Vulcan on the F-4E using the extended nose section of the RF-4C. The combined weight of the gun and ammunition shifted the center of gravity of the plane forward. To fix this, a seventh fuel cell was added to the rear, the radar was replaced with the new AN/APQ-120, and the existing J79-GE-8 engines were replaced with the more powerful J79-GE-17 engines (each can generate 17900 lbs. of thrust) to compensate the increased weight. Also, F-4E Block 48 models were fitted with leading-edge slats to increase the aircraft maneuverability. The United States Air Force retired the F-4s from active duty in 1996, and just like the Navy continued to use the planes as target drones until January 1, 2017.

International F/RF-4 Phantom II Users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Germany

In the 1960s, the F-104G Starfighter became the standard aircraft of NATO and Luftwaffe (German Air Force). By the early 70s, the F-104G was struggling to meet the needs of users. Luftwaffe wanted a high performance, reliable and fast aircraft that could fly in any weather condition. Due to the high losses with the F-104Gs, they sought for a twin-engine plane. Germany first ordered 88 RF-4Es in 1969 and then ordered another 175 F-4F Phantom II on June 24, 1971. Under this agreement, Messerschmitt-Bölkow-Blohm (MBB) would manufacture parts for F-4Fs, and MTU would produce 448 J79-GE/MTU-17A engines. Although the F-4Fs produced specifically for Luftwaffe were a version of the F-4E, there were some significant differences between them. These changes include the replacement of the internal fuel cell number 7 with an APU (Auxiliary Power Unit) for the hydraulic pressure system, the non-slotted version of the horizontal stabilizer, and APQ-120 [V5] radar which did not support AIM-7 Sparrow missiles.

In the early 90s, Germany decided to modernize 113 F-4Fs and launched the ICE (Improved Combat Efficiency) program. Under the ICE program, Hughes AN/APG-65Y digital multi-mode radar, AIM-120 AMRAAM missile firing capability, Honeywell H-423 laser gyro inertial navigation system (INS), the GEC Avionics CPU-143/A digital central air data computer, and MFD (Multi-Function Display) screens were added to the aircraft. Germany retired her F-4Fs in 2013.

Australia

In the 1960s, McDonnell Douglas offered a special F-4C model for the Royal Australian Air Force (RAAF). Instead of the General Electric (GE) J79 engine, F-4C would be powered by the French SNECMA Atar 9 turbojet engine. The Atar 9 was also the engine of the Dassault Mirage III planes used by the RAAF at the time. The Royal Australian Air Force (RAAF) did not accept this offer and instead decided to buy General Dynamics F-111C. Because of the problems and delays encountered in the development process of the variable-sweep wing F-111C aircraft, in May 1970, it became evident that the delivery of the first plane could not be completed before 1974. Therefore the Royal Australian Air Force agreed to lease F-4E from the United States Air Force (USAF) to replace the age Canberra B.20 bombers in the RAAF fleet until the F-111C was received.24 aircraft produced for USAF were leased to RAAF for two years at a total cost of $US41,554 million under the "Peace Reef" program which was signed on June 22, 1970. All 24 aircraft were delivered to Australia between September and October.

In 1972, the delivery of the F-111Cs started earlier than expected. Therefore, the F-4Es were sent back to the US gradually, and the last RAAF F-4E returned to the USAF on June 21, 1973. During the three-year service of the planes, only a single aircraft was lost due to an accident. Phantom A69-7203 crashed on June 16, 1971, during a night bombing sortie on the Evans Head range. Twenty-one of the returned planes were converted to F-4G and used for the Suppression of Enemy Air Defences (SEAD) missions.

South Korea

The Republic of Korea Air Force purchased 18 secondhand F-4Ds in 1968 under the Peace Spectator program and acquired a total of 92 F-4Ds in the following period. The ROKAF also ordered 37 new-built F-4Es and started receiving these aircraft in 1978. They received 23 RF-4Cs from the USAF in 1990. The RF-4Cs are officially retired, and a small number of F-4Es are still active.

United Kingdom

In July 1964, the Royal Navy ordered two F-4K (FG.1) prototypes for use on aircraft carriers. They decided to install Royce Spey turbofan engines, which are powerful than the J79, on the prototypes developed based on the F-4J model. These provided extra thrust for operation from smaller British aircraft carriers. Compared to the J97 turbojets, Spey engines would reduce fuel consumption and increase take-off performance. The introduction of new engines into the Phantom required significant structural changes. The air intake area was increased by twenty percent, and the aft fuselage under the engines had to be redesigned. Since these changes caused more drag, they could not provide the expected increase in performance. Besides the

Navy, the Royal Air Force (RAF) also asked for the Phantom. They initially wanted to buy the F-4C, but the government disagreed and decided to buy the F-4M (FGR.2), the Spey-powered version of the F-4C. A total of 170 (52 K and 118 M) Phantoms were acquired. The need for new aircraft emerged after the Falkland war, and consequently, 15 F-4Js were purchased from the US Navy in 1984. The United Kingdom officially retired the Phantoms in October 1992 and replaced them with Panavia Tornadoes.

Iran

Iran received 32 F-4D, 177 F-4E, and 16 RF-4E between 1968 and 1979. On February 28, 1979, the United States imposed sanctions on Iran after the Islamic revolution and the exile of Reza Shah Pahlavi, the Shah of Iran. As a result of the arms embargo, the Imperial Iranian Air Force (IIAF) could not receive 31 F-4E and 11 RF-4E. Phantoms played an active role in the Iran - Iraq war that started on September 22, 1980. Although few, the Islamic Republic of Iran Air Force continues to use the F/RF-4s actively despite the embargo.

Israel

Israel is the largest foreign operator of Phantom with the 240 F-4E and RF-4E it bought between 1969 and 1976. Israel declared its intention to buy Phantom for the first time in 1965, but the United States did not accept this request. However, as a result of Israel's losses after the Six-day war in 1967, the arms embargo imposed by France and Soviet arms sales to Arab countries changed the opinion of the U.S. government. Under the "Peace Echo I" program, Israel purchased 44 F-4E and 6 RF-4E aircraft in September 1969. In the War of Attrition that took place between Egypt and Israel between 1969 and 1971, the Israeli Air Force (IAF) used the Phantoms for the first time during its attack on the Egyptian air defence units located west of the Suez Canal on October 22, 1969. The Israeli F-4Es scored their first air victory on November 11, 1969, by downing an Egyptian Mig-21. The F-4E Phantoms, which are relatively weaker when compared to the Israeli F-15, F-16, and the other aircraft used by the Air Forces of the Arab states, were upgraded in 1987 under the Kurnass 2000 modernization project. Phantoms refitted to Kurnass 2000 standard underwent many changes, including new radar, HUD (Head-Up Display), mission computer, MFD (Multi-Function Display), HOTAS (hands-on-throttle-and-stick), radio, avionics, and structural strengthening. Israeli Phantoms saw extensive combat during Arab–Israeli conflicts. Between 1969-1982, Israeli F-4Es shot down 116 hostile aircraft in these battles, whereas 55 Phantoms were lost to the enemy fire. The last Israeli F-4s were retired in 2004.

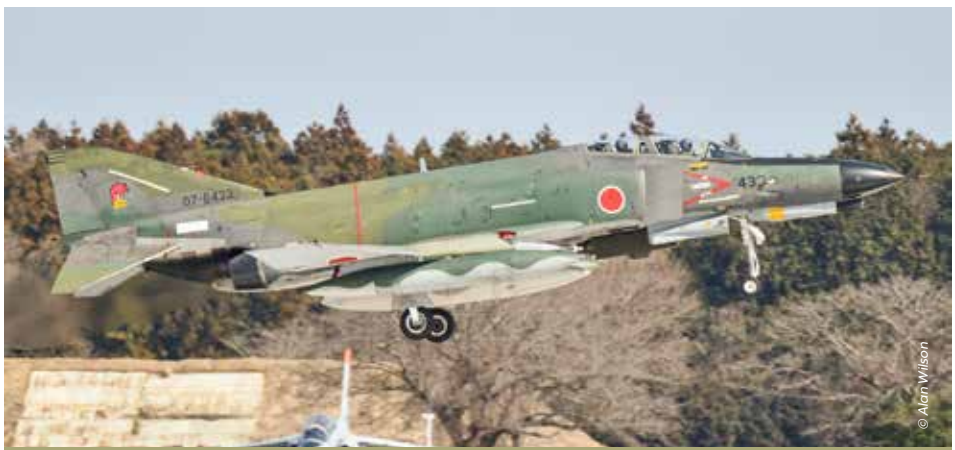
IDFAF's 201st Squadron F-4E Kurnass 2000

Spain

The Spanish Air Force acquired 36 ex-USAF F-4C Phantoms between October 1971 and September 1972 under the "Peace Alfa" program. Later, Spain purchased 4 F-4C and 4 RF-4C under the "Peace Alfa II" program in 1978 and an additional 8 RF-4C in 1989. In 1995, Spain received another 6 RF-4Cs to replace the first RF-4Cs. The last Spanish Phantoms were retired in 2002.

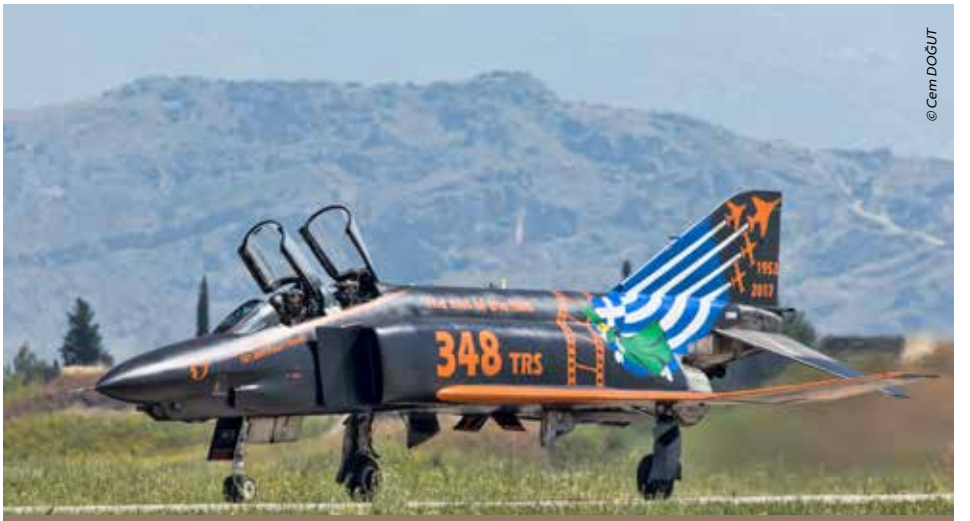
Japan

From 1968, the Japan Air Self-Defence Force (JASDF) imported 14 unarmed reconnaissance RF-4E and purchased a total of 140 F-4EJ



RF-4EJ's that had been modernized by KAI project, were the part of the 501st Tactical Reconnaissance Squadron in JASDF

Phantoms without aerial refueling, AGM-12 Bullpup missile system, AN/AJB-7 bombing system, nuclear control system or ground attack capabilities. The first two F-4EJs were produced by McDonnell Douglas, while the remaining 138 aircraft were manufactured under license in Japan by Mitsubishi Heavy Industries. These are the only Phantoms built outside the United States. One of the planes (17-8440) was the very last of the 5,195 F-4 Phantoms manufactured in the world. Mitsubishi delivered it on May 20, 1981. In the late 80s, 110 out of 125 aircraft in service were planned to be modernized, but this number was later reduced to 96 because of budget constraints. Under the "Kai" modernization program AN-APG-66J pulse-doppler radar, new mission computer, Kaiser Heads-Up Display, AN/APZ-79 IFF, LN-39 INS and J/APR-6 RWR systems were installed on the F-4EJ aircraft. 11 RF-4Es were included in this program and upgraded to the RF-4E Kai standard and equipped with new AN/APQ-172 radar, J/APR-5 RWR, and LN-39 INS. 17 F-4EJs were converted into reconnaissance aircraft and designated as RF-4EJ after receiving a similar upgrade. RF-4EJs can carry LOROP (Long Range Oblique Photography - KS-146B camera), TAC (Tactical Camera Pod - KS-135A, and KS-95B cameras or D-500UR IR camera) and TACER (Tactical Electronic Reconnaissance - ELINT) under-fuselage pods for reconnaissance missions.



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RF-4E was the part of 348th Tactical Reconnaissance Squadron in the Hellenic Air Force

Japan will retire its Phantoms this year and replaced them with F-35A Lightning II.

Egypt

Egypt started to receive economic aid from the US after the Camp David agreement signed with Israel in 1978. Before the agreement, the Egyptian Air Force (EAF) was using Russian aircraft. In 1979, the Egyptian Air Force purchased 35 former USAF F-4Es from the United States as part of the "Peace Pharaoh" program. In exchange for the Phantoms, the US decided to buy some Mig-21 and Mig-23 aircraft from Egypt to give a chance to examine these planes firsthand. Egypt began receiving the aircraft in September 1979; however, as the Egyptian Air Force used to fly Russian planes, they had a hard time keeping the Phantoms ready for combat missions. Egypt even thought to sell these planes to Turkey in 1982. Later, with the new training programs and the support of the US, the number of active aircraft increased in 1985. By 2020, all the EAF Phantoms are retired.

Greece

The Hellenic Air Force ordered 121 F/RF-4E Phantoms in total with deliveries starting in March 1974. In 1997, Greece upgraded a total of 39 F-4E aircraft under the "Peace Icarus 2000" (29 Peace Icarus I and 10 Peace Icarus II) modernization program. As part of the modernization, AN APG-65 radar, GEC-Marconi HUD, GPS/INS, and MFDs were installed on the aircraft. The modernized planes were later designated as F-4E AUP (Avionics Upgrade Program). The Hellenic Air Force officially retired the RF-4E Phantoms on May 5, 2017, while around 20 F-4E AUPs are still active.


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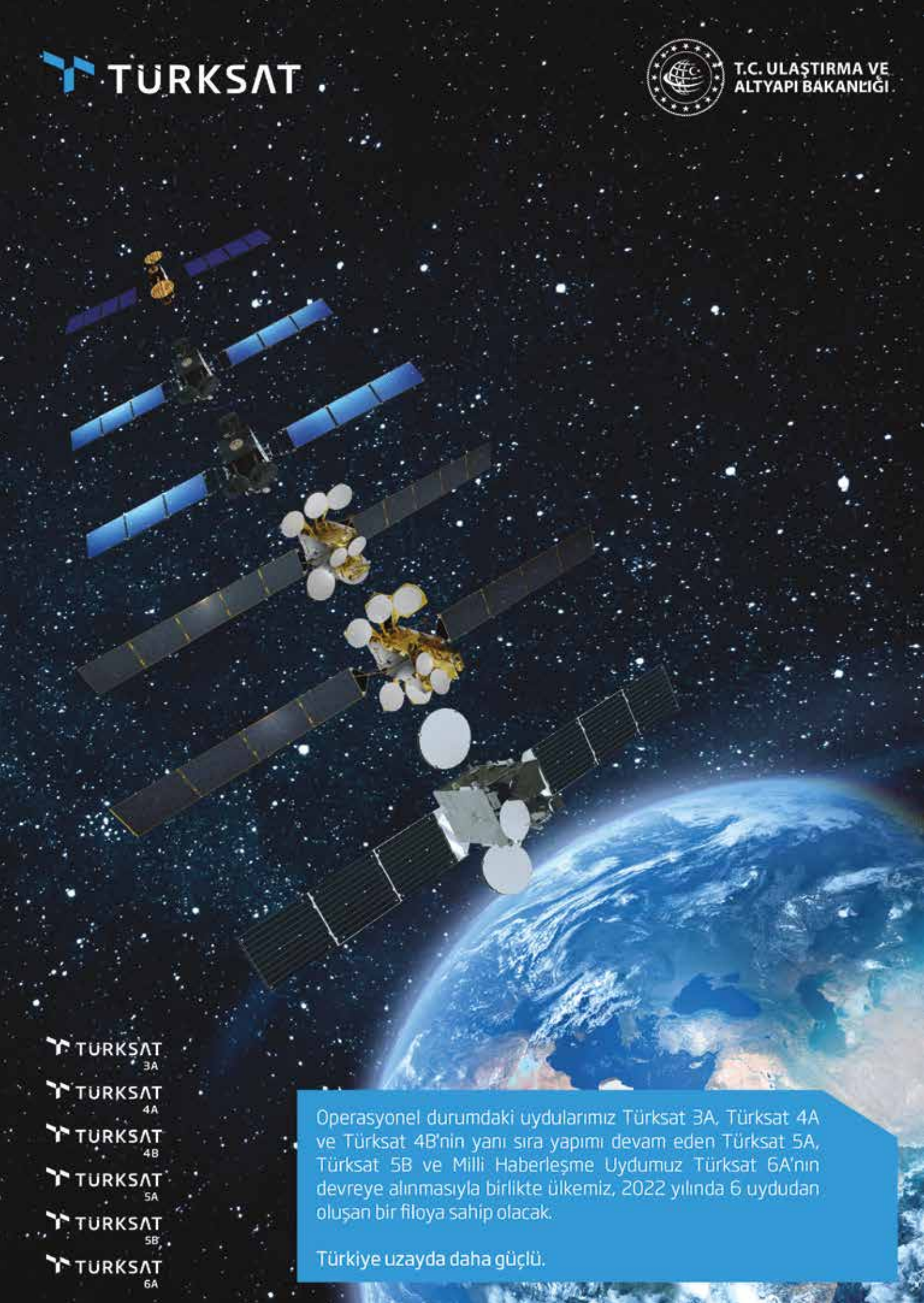
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T.C. ULAŞTIRMA VE ALTYAPI BAKANLIĞI
TÜRKSAT 3A
TÜRKSAT 4A
TÜRKSAT 4B
TÜRKSAT 5A
TÜRKSAT 5B
TÜRKSAT 6A
Operasyonel durumdaki uydularımız Türksat 3A, Türksat 4A ve Türksat 4B'nin yanı sıra yapımı devam eden Türksat 5A, Türksat 5B ve Milli Haberleşme Uydumuz Türksat 6A'nın devreye alınmasıyla birlikte ülkemiz, 2022 yılında 6 uydudan oluşan bir filoya sahip olacak.
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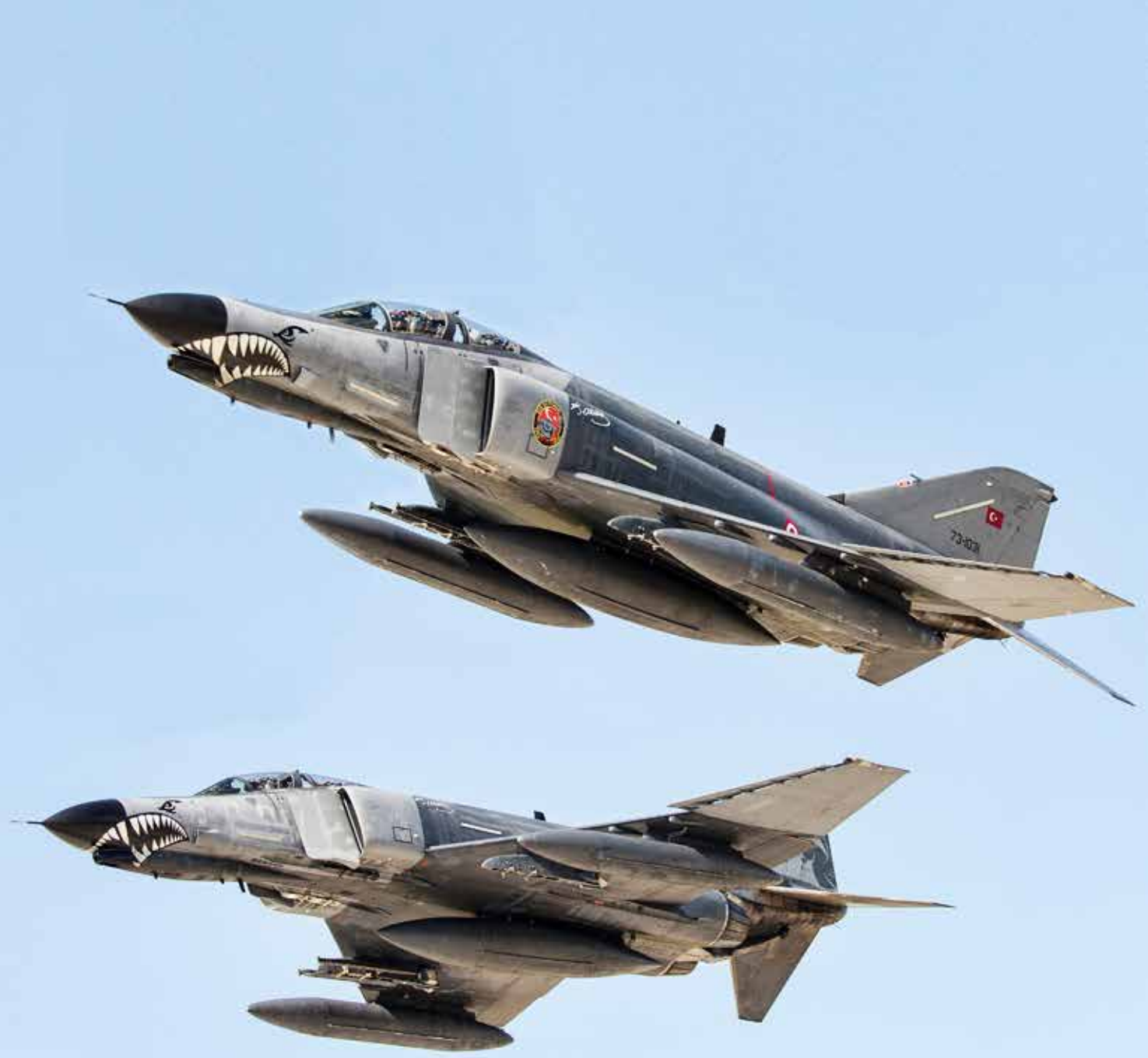
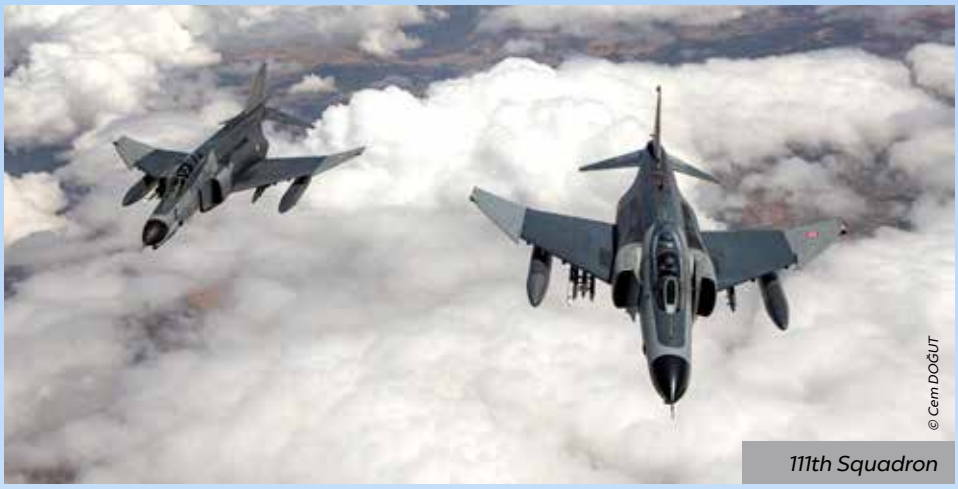


F/RF-4E phantom II
IN THE TURKISH AIR FORCE

The needs of the Turkish Air Force Command (TurAF) were mostly met by the United States Military Assistance Program (MAP) under the Marshall Plan, which started in 1948. When Turkey became a member of the North Atlantic Treaty Organization (NATO) in 1952, large amounts of aircraft were acquired with the help of other NATO countries, primarily the United States (USA). By the 1960s, the striking power of the Turkish Air Force was formed by the F-84 Thunderstreak and F-100 Super Saber aircraft, which were acquired through the assistance program. In addition to these, TurAF was also operating a small number of F-5 Freedom Fighter and F-104 Starfighter aircraft. Due to the problems that started in Cyprus in 1960 and the crisis that escalated with Greece after the intervention on the island in 1964, the need for a new multi-role fighter plane emerged in the early 1970s.

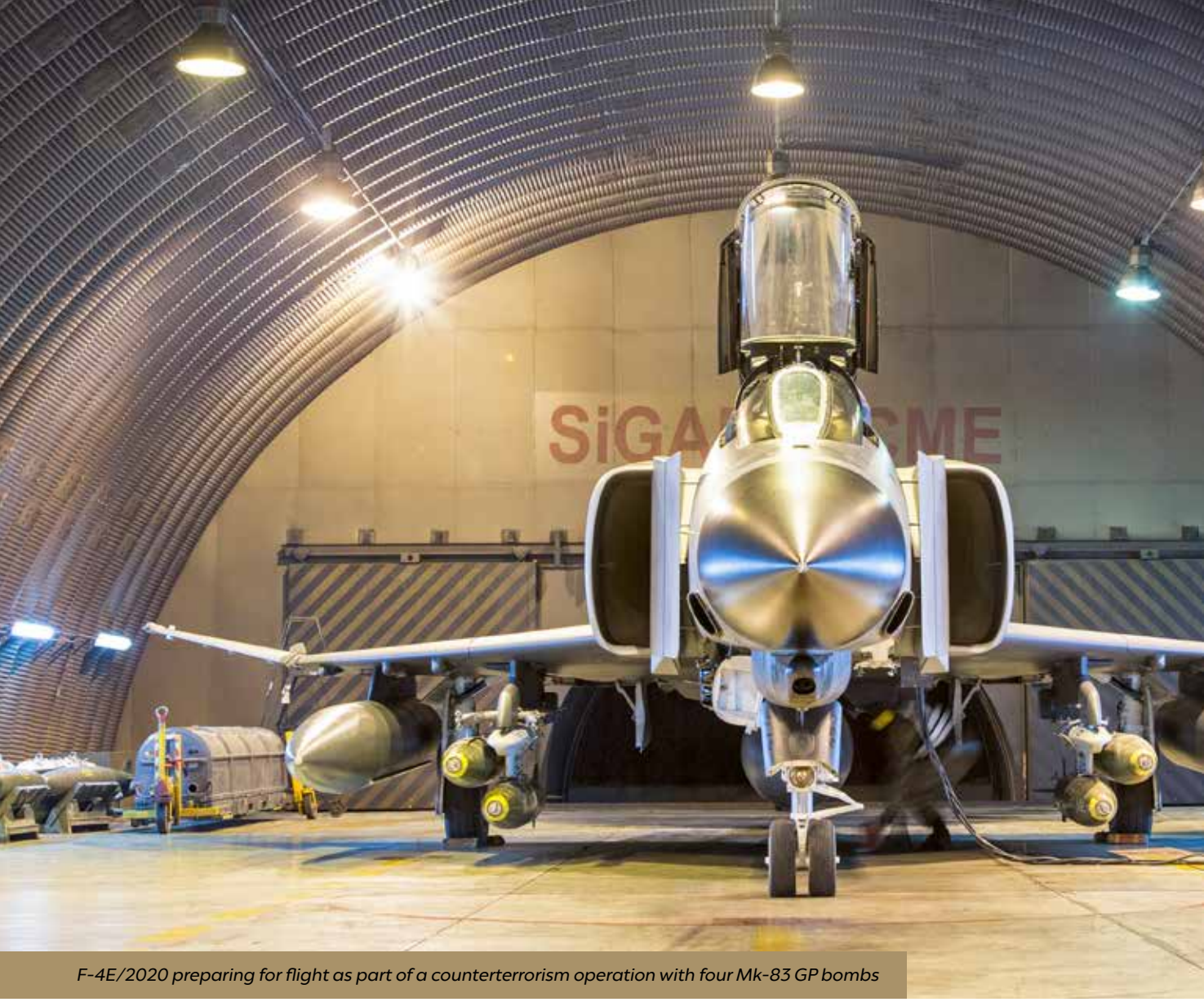


111th Squadron

The acquisition of 36 F-4E Phantom II by Greece under the Peace Icarus Project in 1971, highlighted the necessity of meeting the modern and powerful aircraft need of the Turkish Air Force. Contract negotiations with the USA started in February 1972 and were completed in a short time, and the Peace Diamond project was launched within the same year. A total of 40 F-4E Phantom II aircraft were ordered, and the project was financed from the national budget. Within the scope of the order, the necessary supply, spare parts, and facility support needs of the Eskişehir and Erhaç/Malatya Jet Air Bases, as well as the personnel selection and training programs, were also planned.

With the arrival of two F-4E Phantom II (73-1016 and 73-1017) aircraft to the 1st Main Jet Base Command with US pilots on August 30, 1974, the Phantom page was officially opened in the history of Turkish aviation, and the incoming Phantoms entered service with the 113th "Tayfun" ("Typhoon") Squadron, established the same year at Eskişehir. F-4Es were taken to the Turkish skies for the first time by Tayfun Squadron Commander Major Ergin Celasin and Captain Ziya Alemdar with the Phantom 73-1016 on September 2, 1974. Squadron personnel became combat-ready in mid-1975. With the introduction of F-4E Phantom IIs, the Weapon Systems Officer (WSO) class, which was not exist in the Turkish Air Force, was introduced and "Şimşek" ("Lightning") Air Wing, which was established under the Squadron in 1976, began the combat readiness training of the F-4E Phantom II weapon system officers. 8 F-4E Phantoms, delivered in 1974, were assigned to the 113th Squadron. Of the 32 planes that delivered in 1975, 12 were assigned to the 113th Squadron, and the remaining 20 were assigned to the 112th "Şeytan" ("Devil") Squadron. As part of the Peace Diamond II Project, 32 F-4E Phantom II and 8 RF-4E Phantom II aircraft were ordered in total. An interesting feature of the Peace Diamond II Project is that the 5000th serial production F-4E was delivered to the Turkish Air Force with the tail number 77-0290 within the scope of this project. The 172nd "Şahin" ("Falcon") Squadron and the 111th "Panter" ("Panther") Squadron were modernized with the aircraft that had been purchased since April 1978 under the Peace Diamond II Project. The 113th Squadron, the first F-4 Squadron established in 1974, disbanded on July 3, 1979. Instead, the 114th Squadron, which was established for the second time in 1977, was named as the 113th Squadron in 1979, and 8 RF-4E Phantom II planes, which were delivered under the Peace Diamon II between 1978-79, were assigned to the "new" 113th Squadron. The "Tayfun" call sign, which was used when flying with the F-4E in 1974, was changed to "Işık" ("Light") with the introduction of RF-4E aircraft to the Turkish Air Force.

With the delivery of F-4E Phantom II aircraft, modern munitions such as TV-guided AGM-65A/B Maverick air-to-ground missiles (AGM), AN/AVQ-23 Pave Spike laser targeting pods, laser-guided 500 and 2000 lb GBU-10/12 Paveway I/II and electro-optical guided 2000-pound GBU-8 HOBOS bombs were also entered to the TurAF inventory. In this way, the Turkish Air Force gained the precision strike capability against air-ground targets for the first time in its history. In addition to these modern munitions, medium-range semi-active radar homing AIM-7E Sparrow and short-range infrared heat-seeking AIM-9B/P Sidewinder missiles were started to be used for air-to-air missions. Furthermore, one of the



F-4E/2020 preparing for flight as part of a counterterrorism operation with four Mk-83 GP bombs

most effective electronic countermeasures (ECM) system, ALQ-119 pods were also introduced to increase the electronic warfare capability and protect the aircraft against radar-guided surface-to-air (SAM) missiles. Thanks to the APQ-120 radar, which is considered to be the advanced technology system of its time, the F4E Phantom II can carry out interceptions day and night, in all weather conditions. Thus, the 112th and 172nd Squadrons were assigned as an all-weather fighter-interceptor squadron with Sparrow and Sidewinder missiles.

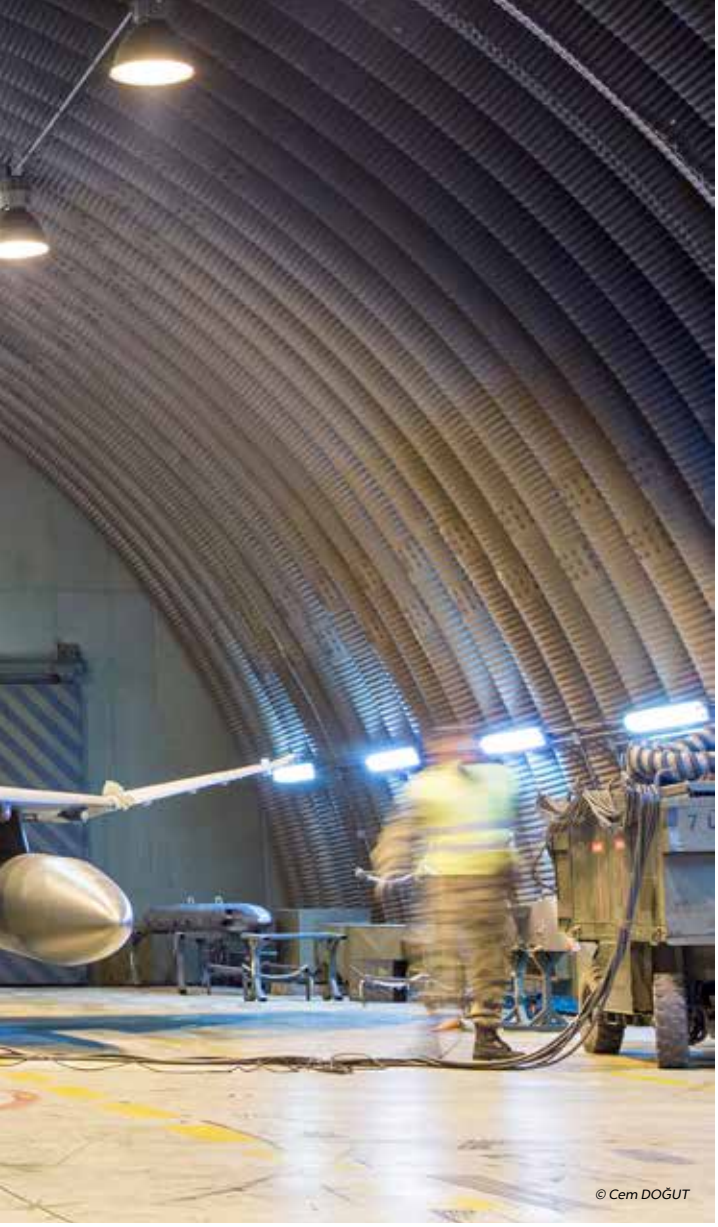
As part of the Peace Diamond III Project, 15 F-4E Phantom II aircraft were supplied from the Aircraft Maintenance and Regeneration Center (AMARC) in the USA from July 1981 to April 1984. These planes, which were purchased under the Peace Diamond III project, were assigned to the 173rd Squadron after painted in Southeast Asia (SEA) camouflage.

Within the scope of the Peace Diamond IV Project, 15 ex-USAF F-4E aircraft were purchased between 1984 and 1985 to replace the losses of the four Phantom squadrons.

Within the scope of the Peace Diamond IV Project, 15 ex-USAF F-4E aircraft were purchased between 1984 and 1985 to replace the losses of the four Phantom squadrons. These planes were followed by 40 ex-USAF Aircraft F-4E Phantom II aircraft with Peace Diamond V Project in 1987. These aircraft were first modernized in the 131st "Ejder" ("Dragon") Squadron and later in the 132nd "Hançer" ("Dagger") Squadron at 3rd Main Jet Base Command in Konya.

In 1991, military aid was received from the USA and its allies as a result of the support given to Operation Desert Storm, launched by the US-led coalition to remove Iraq from Kuwait. In this context, as part of the Peace Diamond VI Project, 40 ex-U.S. Air National Guard Aircraft F-4E aircraft were received between 1991-1992.

Under the Kaan project, Turkey purchased a total of 46 ex-Luftwaffe RF-4E aircraft, which became surplus after the unification of East and West Germany in 1990 and the end of the Cold War. While 12 of the planes were purchased as spare parts, 34 RF-4Es were undergone an extensive upgrade by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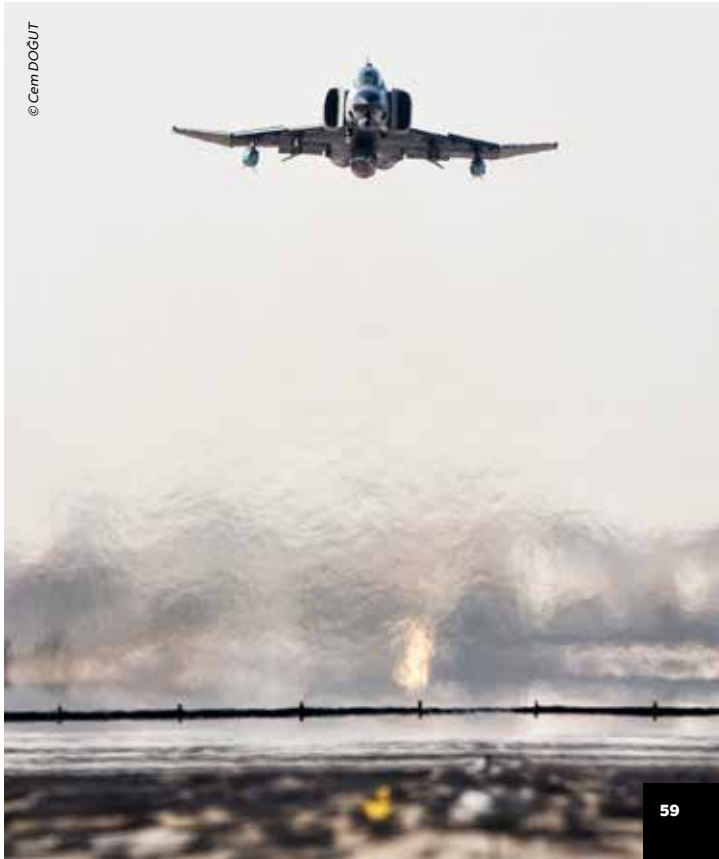
Messerschmitt-Bölkow-Blohm (MBB) before delivery. Within the scope of modernization, the aircraft's AN/APQ-99 radars were replaced with the AN/APG-172 radar system, which was also used in the USAF RF-4Cs that recently modernized by the US Air Force. The deliveries began in 1992 and were completed in 1994, and the planes were assigned to the 113th and 173rd Squadrons. In 1994, the Bora Air Wing was established in Eskişehir, and RF-4E training was started to transform the 173rd Squadron in Malatya into a reconnaissance role.

F-4E/2020 "Terminator" Modernization

Making its maiden flight in 1958, the Phantoms represents the technology of the 1960s. Thanks to their standard APQ-120 radar system, the Phantoms successfully carried out air-to-air missions until the mid-80s. However, by the 90s, the existing F-4E Phantom II aircraft in the Turkish Air Force inventory reached high values in terms of both airframe life and flight hour rates. Eventually, they have become outdated and could not respond to current needs and threats. Turkey had two alternatives to maintain its strong military position in the region and to increase its deterrence. In line with this need, Turkey would either replace the old Phantom aircraft with a new twin-engine fighter-bomber or upgrade some of the existing F-4E Phantom II aircraft with a comprehensive modernization project to increase their service life for at least 20 more years. Turkey favored the modernization option for economic reasons. Turkey's 30 years of experience in training, equipment, materials, repair, maintenance, and logistic support capability were also played a significant role in this decision.

German DASA and Israeli IAI companies submitted their proposals to the project, which was launched for the structural and avionics modernization of F-4E aircraft. The German offer included the replacement of the AN/APQ-120 fire control radar of the F-4E with the AN/APG-65 radar used in the F/A-18 Hornet, next-generation avionic displays, mission computer, flight control system, a new navigation system, and the capability to launch AIM-120 Advanced Medium-Range Air-to-Air Missiles (AMRAAM) with the MIL-STD-1553B data bus. On the other hand, the IAI solution based on the Kurnass 2000 developed for the Israeli Air Force included the replacement of the existing radar with ELTA product EL/M-2032 and the integration of AN/ALQ-178[V]3 electronic countermeasure system, MXF-484 VHF/UHF radio, HOTAS flight control system, heads-up display (HUD), integrated INS/GPS navigation system, airborne videotape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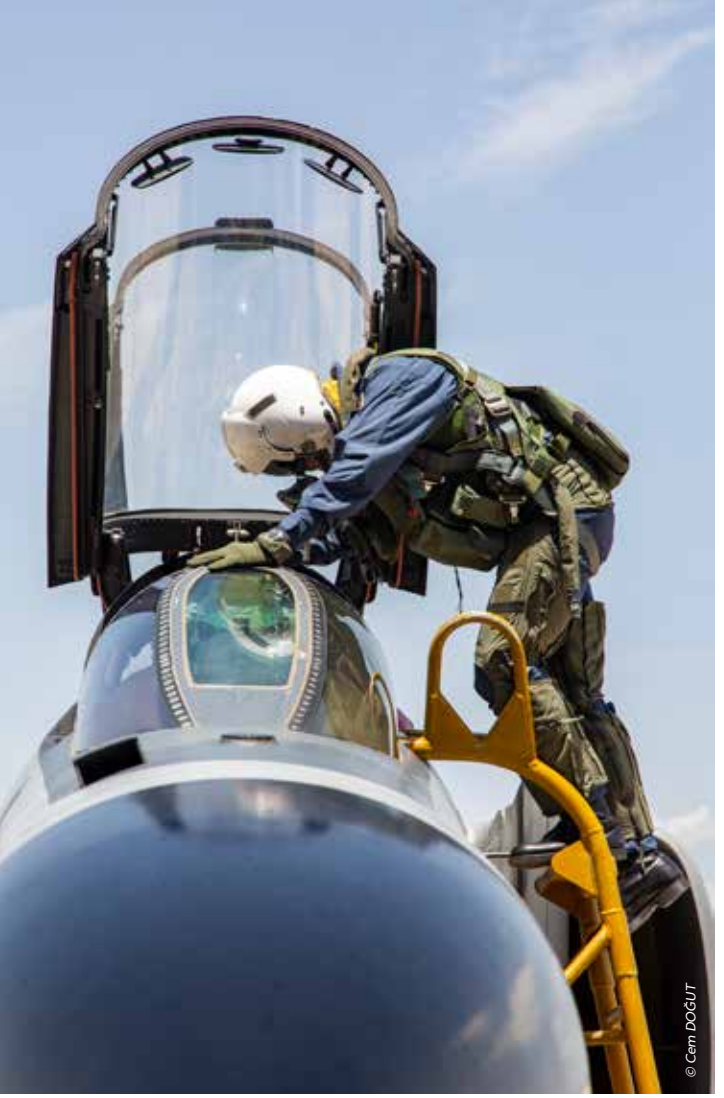


recorder (AVTR), full-color multi-function displays (MFD), a new mission computer and MIL-STD-1553B data bus. Furthermore, the aircraft would gain the ability to ability to fire Popeye-I air-to-surface guided missiles (ASM) and carry ELTA EL/L-8225 electronic warfare pod.

The EL/M-2032 radar provided a cost advantage as well as a political advantage in technology transfer as there is no need to obtain permission from the USA. Turkey examined the technological and operational capabilities of the radar and stated that it is at least as successful as AN/APG-76 in terms of performance. Turkey accepted the IAI's offer and chose the ELTA product EL/M-2032 radar for the modernization of the Turkish Phantoms.

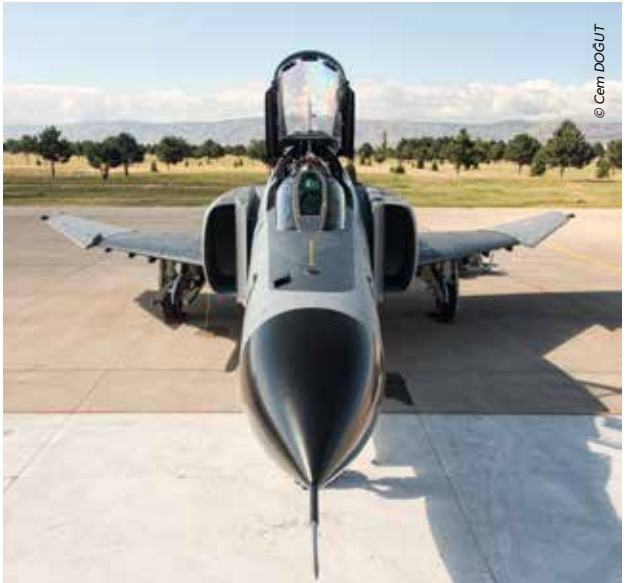
After evaluating the offers, Turkey reached an agreement with IAI and signed a contract worth US$632,5 million with the company in 1997. Within the scope of the project called Terminator, all wiring equipment of the planes to be modernized would be changed, and their airframes would be strengthened. According to the agreement, 26 of the 54 F-4E Phantom aircraft were to be modernized in Israel, and the remaining 28 were to be upgraded in the 1st Air Supply and Maintenance Center of the Turkish Air Force located in Eskişehir. According to the agreement, Israel would provide the necessary structural and avionic modernization kits for the 28 planes to be modernized in Turkey, train Turkish engineers for avionic integration, establish a System Integration Laboratory (SIL), and transfer this laboratory to Eskişehir. Thanks to this technology transfer provided by Israel within the scope of the project, the 1st Air Supply and Maintenance Center was planned to acquire the capability to carry out the desired structural and avionic changes on the aircraft by improving the technological infrastructure of the center. The first two F-4E/2020 (73-1032 and 68-0498) were delivered to the Turkish Air Force with a ceremony held on January 27, 2000. The two aircraft received were transferred to the 111th Squadron. The first F-4E/2020 was delivered to the 171st Squadron on December 21, 2001.

If we look at the post-modernization capabilities of the F-4E/2020 aircraft;

Produced by the Israeli ELTA company, the EL/M-2035 is an X band Pulse-Doppler multi-mode radar with SAR/GMTI (Synthetic Aperture Radar/Ground Target Moving Indicator) capability. Thanks to the SAR/GMTI function, the EL/M-2035 radar can display tanks, armored vehicles, howitzers, missile batteries, aircraft (on the ground), land-based radars, and other mobile-stationary or land-surface targets with a resolution close to photographic quality. The range and coordinates of the ground targets can be determined from the pictures collected with the SAR/GMTI mode.

It is possible to summarize the Mil-STD 1553 system as a computer program that enables the avionics and weapons systems on the aircraft to communicate with each other. Thanks to the system, which consists of both software and hardware, all modern weapons can be easily certified and integrated into the aircraft.

The Heads-up Display (HUD) is a system that shows the critical flight and tactical data of the aircraft at eye level by projecting it onto a



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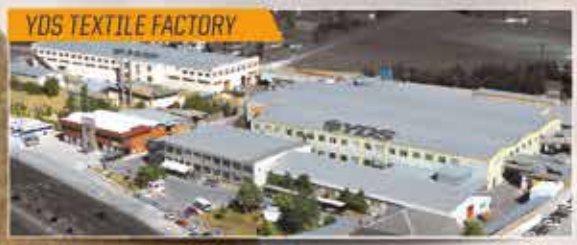

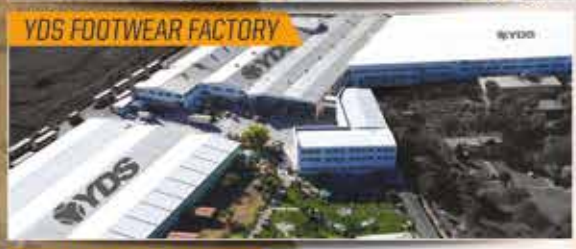

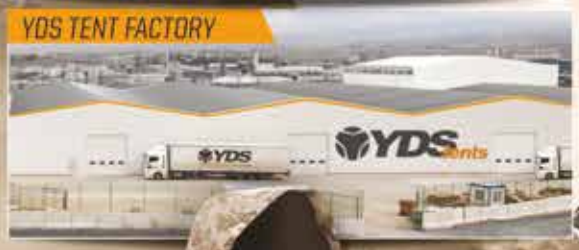

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transparent glass behind the front canopy. Thus, pilots can access this vital information without requiring looking away from their usual viewpoints and concentrate on flying the aircraft.

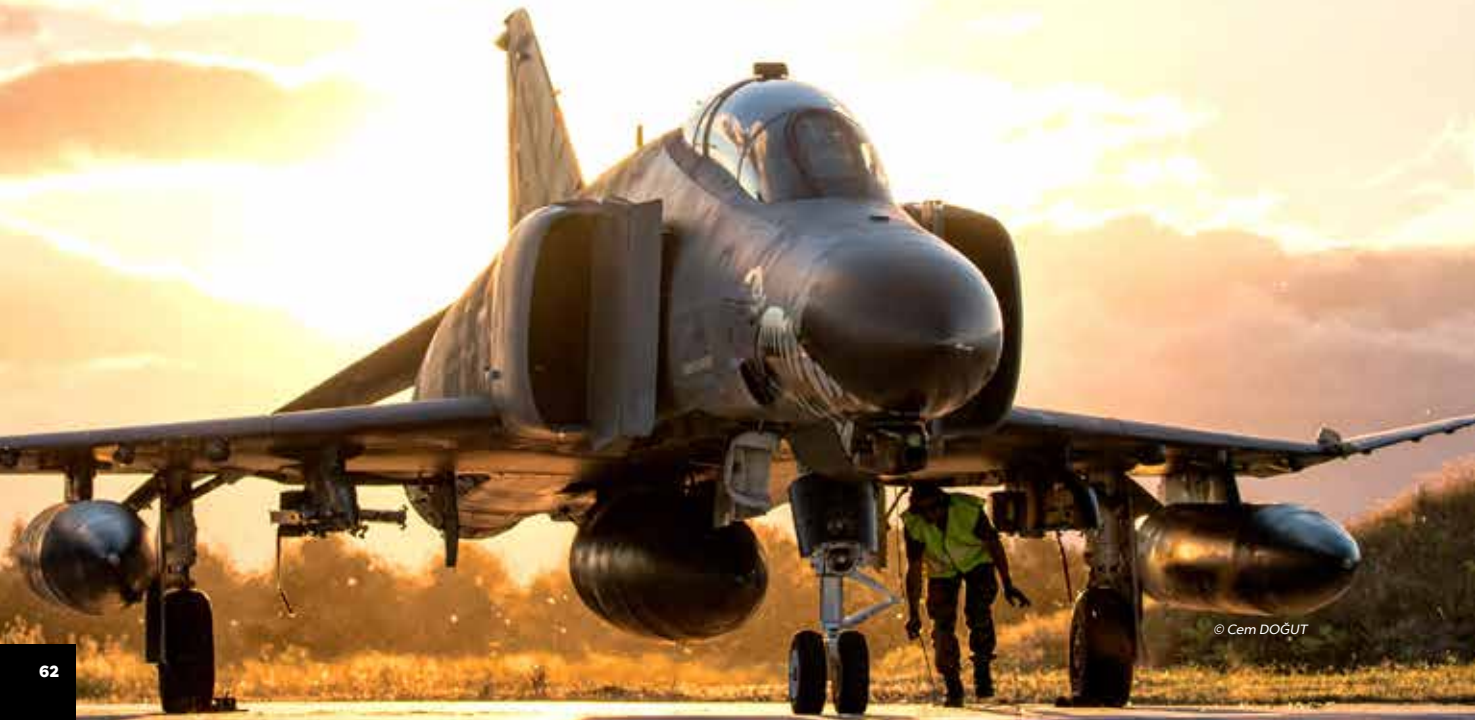
The hands-on throttle-and-stick (HOTAS) is the concept of placing buttons and switches on the throttle lever and flight control stick in an aircraft's cockpit, allowing pilots to access vital cockpit functions and fly the plane without having to remove their hands from the controls. The system gives the pilots the ability to manipulate all the essential radar functions without moving their hands away from the stick or throttle. Other features include weapon release, radio communications switch, chaff & flare countermeasure activation, speed brake controls, nose wheel steering, and aerial refueling disconnect.

RF-4E/TM Reconnaissance Aircraft, 173rd Squadron

A total of three Multi-function Displays (MFD) were added to the cockpit of the F-4E/2020 Terminators, one in the front seat and two in the rear seat. All the radar, navigation, equipment, and other flight information can be checked and, if necessary, changed from these displays. Sitting in the back, the Weapon Systems Officer (WSO) can control different systems such as radar and weapons from two displays on the rear seat instrument panel.

Thanks to the INS/GPS navigation system added to the aircraft, the Terminators can navigate from one point to another point precisely, and the absolute position of the plane can be determined. The system, in principle, calculates the latitude and longitude information very accurately and transmits its navigation coordinates to the flight control computer. Position data of the flight zone or the designated targets can be uploaded to the INS/GPS, which is calibrated and programmed on the ground before take-off. Therefore, pilots can locate their targets easily and engage with high precision.

Thanks to these Have-Quick compatible MXF-484 VHF/UHF band radios integrated into the aircraft, air-to-air and air-to-ground communication can be done without being jammed and intercepted. These radios use the NATO radio communication standard Have-Quick protocol to minimize jamming and interception risk. The antenna of these new radios is a large black



antenna placed on the aircraft fuselage. This antenna creates the most significant visual difference that distinguishes F-4E/2020 aircraft from other F-4Es.

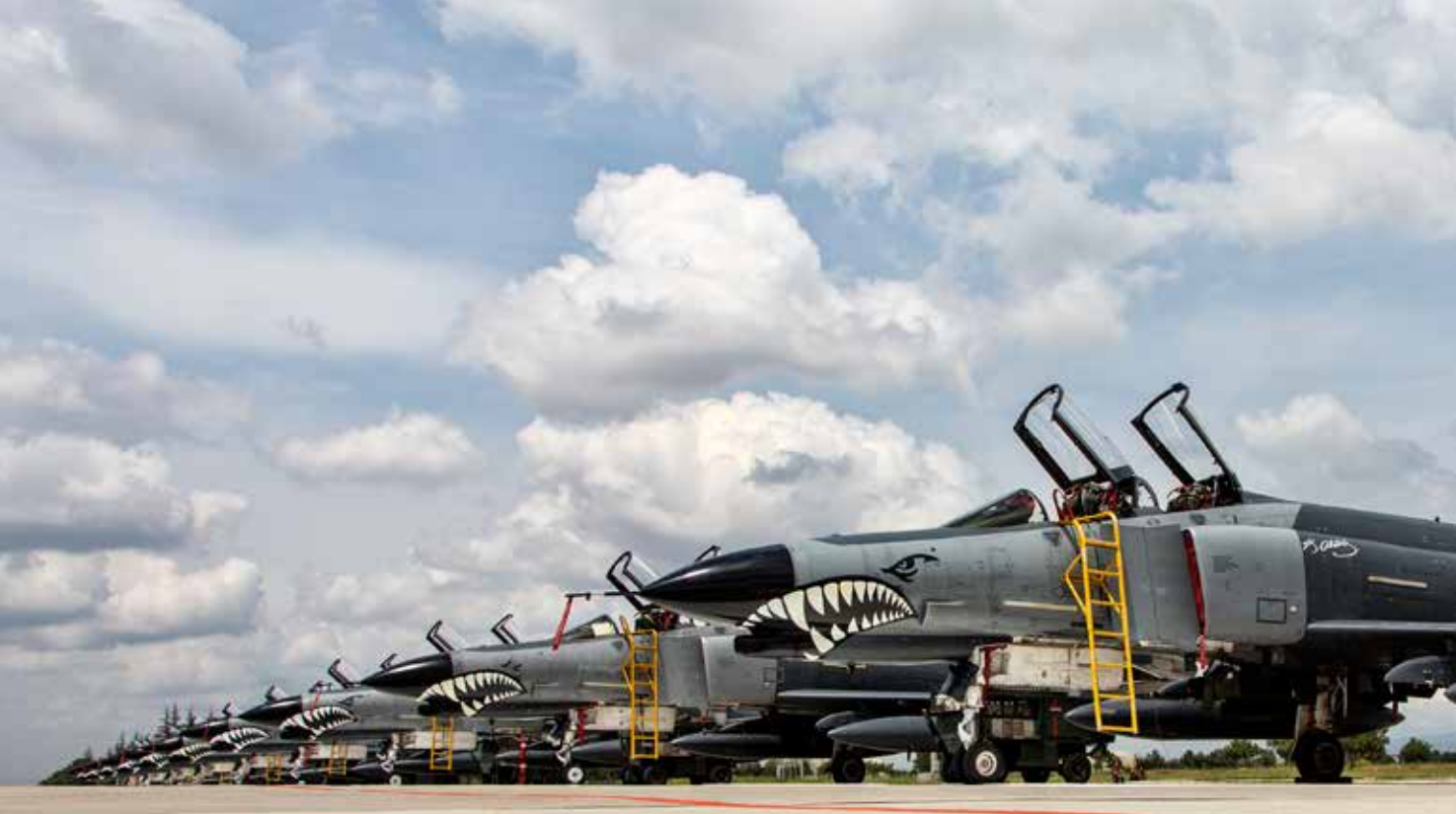
Mikes ALQ-178[V]3 modules were selected for F-4E/2020 aircraft as the radar warning receiver (RWR), which is the standard equipment of every modern fighter jet. The same system was also chosen for the first package of the Turkish F-16 (Block 30/40) aircraft under the Peace Onyx I project. The EL/L-8225 jamming pods produced by Israeli ELTA were purchased as part of the project to provide active electronic countermeasure (ECM) solutions. Together with ELTA, Havelsan provides software control of the system. Passive protection systems integrated into F-4E/2020 aircraft include chaff and flare dispensers for deceiving hostile radar and infrared missiles.

The most significant improvement that increases the strike capability of the Terminators is that the F-4E/2020 aircraft can fire Popeye missiles. The Popeye is a solid-rocket powered stand-off missile weighing 1,360 kg (3,000 lb) with a 340 kg (750 lb) blast fragmentation or 360 kg (800 lb) I-800 penetrating warhead and imaging infrared or TV guidance. It has a reported range of 100 km, depending on its launch altitude. The missile can also be controlled directly through the data link.

"Işık (Light) Project" Turkey's first National Aircraft Modernization

F-4E/2020 modernization was followed by the "Işık (Light) Project." In line with the operational needs of the Turkish Air Force, the Işık (Light) Project, which was the first national aircraft modernization project of Turkey, was initiated to provide 18 RF-4E Phantom II aircraft with the ability and capability to navigate accurately in all weather conditions and to successfully conduct day and night reconnaissance missions under electronic warfare protection.

With the project, 7 RF-4E purchased from the US, and 11 RF-4E aircraft transferred from the German Air Force (Luftwaffe) were modernized. The RF-4E aircraft from the US and Germany had notable equipment and structural differences. The US origin RF-4Es had leading-edge slats like other F-4Es in TurAF inventory, while the Luftwaffe RF-4Es had leading-edge flaps and Boundary Layer Control (BLC). Other structural differences were that the US planes had rounded camera bays, while the German ones had angled camera bays. With the Prototype Phase that started on January 29, 2004, one US and one German RF-4E aircraft were modernized. The



111th and 112th Squadrons

first aircraft, which was upgraded under the Prototype Phase, made its first flight on December 19, 2008, and the second aircraft on January 19, 2009, and the test flights completed on April 16, 2009. The serial Production Phase, which started on August 31, 2007, and covered 16 aircraft, was completed in 2010.

Turkey's first national fighter aircraft modernization project, Işık (Light) Project, was accomplished by the main contractor 1st Air Supply and Maintenance Center (HİBM) Command with its technical/technological knowledge and infrastructure gained from the F-4E/2020 and F-5 2000 Modernization Projects which were also realized with the participation of the 1st HİBM Command. The command carried out various studies including design and final modernization configuration selection, installing and operating the system in a laboratory environment, prototype application on two aircraft, structural modernization, installation and analysis of the avionics, ground and flight tests, and serial modernization. The production of navigation, flight control, and communication equipment of aircraft and their integration using a digital data bus were carried out by Aselsan while MİKES performed the modernization of the Electronic Warfare system.

With the Işık (Light) Project, which was carried out entirely by Turkish engineers, technicians, and pilots, both flight and mission planning systems were made autonomous in RF-4E aircraft, and it was ensured that the planes could find their positions with high precision in all weather conditions.

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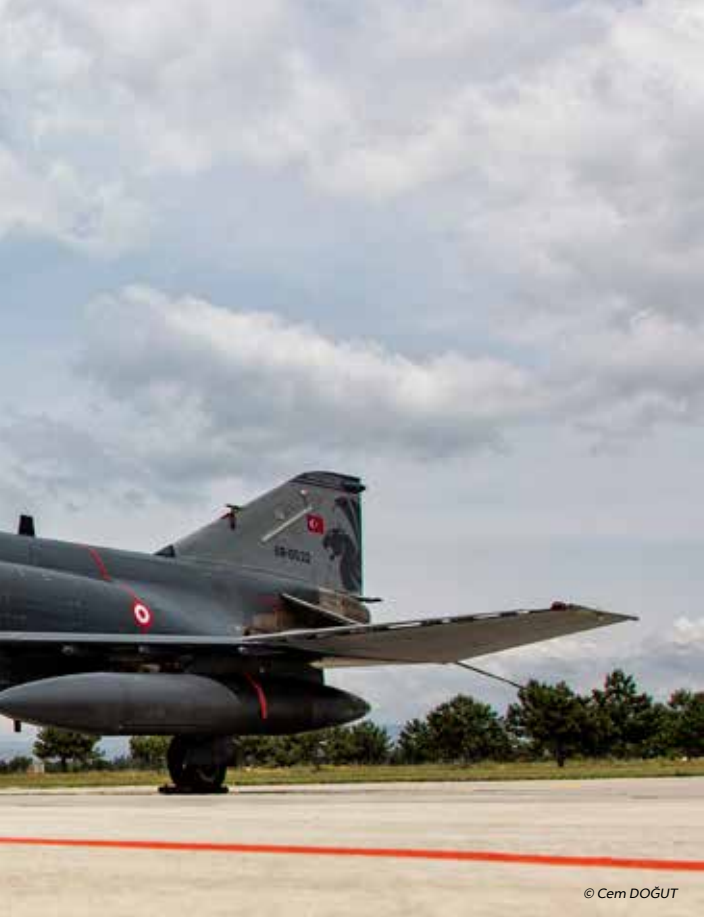
Phantom preparing flight with SUU-20 practice bomb dispenser

The aircraft is also equipped with a system capable of effective, uninterrupted, and secure communication thanks to the new generation digital remote communication systems that are resistant to electronic warfare.

To ensure that RF-4Es can operate safely without any structural failures until the 2020s, 16 critical parts on the aircraft were replaced/reinforced to extend the service life of the jets without disrupting the structural integrity of the planes.

As part of the avionics modernization process, the cockpits of the aircraft were redesigned, including the newly installed instruments and control panels. Moreover, the Avionic Relay Panel was redesigned and manufactured, front and rear seat instrument panels, pedestal panel,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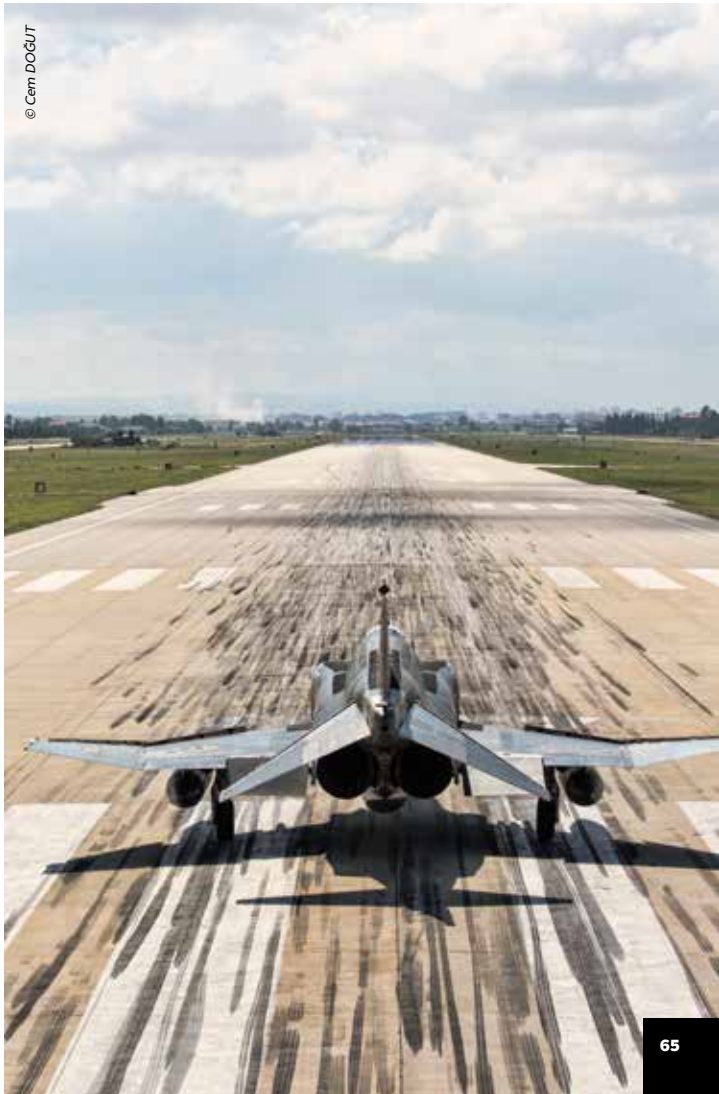
and left and right consoles were also redesigned. In this way, the cockpits of German and US origin aircraft were standardized. New wirings were also produced and installed for the updated avionic system. Within the scope of modernization, the CDU-900Z Control Display Unit, which is the primary interface between the pilot and Flight Control System and the Radar Warning Receiver (RWR) display of the AN/ALQ-173[V]3R passive electronic warfare system were installed to the front seat instrument panel. The CDU-900Z Control Display Unit acts as the center of the flight control system and the primary interface between pilots and the main avionics. RWR Interface Control Unit (ICU), Weapon Control Panel, Avionic Activation Panel (AAP), and Reconnaissance Panel were installed by redesigning the right and left consoles in the front cockpit. Located on the rear seat instrument panel, the RWR interface control unit its display instantaneously provides threat environment information in full color. CDU-900, AAP, and MILSEC-III crypto units were installed by redesigning the rear seat right and left consoles, and some modifications were made on existing panels. The LN-12 Inertial Navigation System (INS) on the RF-4E aircraft was replaced with the LN-100GT Embedded INS/GPS (EGI) system which reduces the nautical miles per hour position error-rate from 3.6nm to 0.8nm when INS is active, and to 10 meters when INS/GPS is used together providing the aircraft with a highly accurate navigation capability. The Pilot and the Weapon Systems Officer (WSO), receive and control the navigation information from the LN-100GT EGI system via the CDU-900Z Control Display Unit. Communication between the upgraded avionics with digital interfaces such as the LN-100GT system and the and the original analog display systems maintained on the aircraft is provided through the SBU-100 Synchro-to-digital Converter Unit which specially designed by Aselsan for this project. The AN/APN-159 radar altimeter system on the plane was replaced with the AN/APN-232 CARA (Combined Altitude Radar Altimeter) system. The communication system of RF-4E reconnaissance aircraft also received an extensive upgrade. The existing RT-793A/ASQ UHF and RT-792/ARC-105 HF radio sets were replaced with two encrypted and Link 11 compatible MXF-484 UHF/VHF Have Quick radio sets delivered by Aselsan. Additionally, 1 ARC-190 HF radio, Avionic Activation Panel, and Throttle Lever PTT (push to talk) Switch were integrated into aircraft. Within the scope of the EW system modernization, the AN/ALR-46 RWR system was replaced with the AN/ALQ-178[V]3R Passive Electronic Warfare System. While the E/J Band antennas of the EW system on Luftwaffe aircraft are located on the right and left side of the front KS-87B camera bay, the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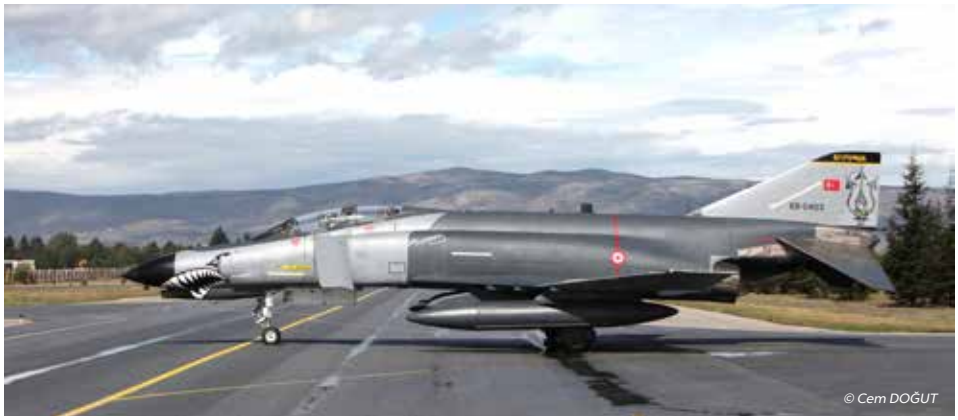

antennas on the US origin RF-4E planes are located at the wingtips. Also, 5 Luftwaffe RF-4E aircraft were upgraded to utilize the KS-146B Long Range Oblique Photography (LOROP) reconnaissance pods with the Işık (Light) Project, raising the total number of RF-4E/TM reconnaissance aircraft to 12. As part of the KS-146B reconnaissance pod system, the Reconnaissance Pod, Control Panel, Power Distribution Unit, and Two-position Side Oblique Optics were installed on the aircraft. The SBU-100 Converter act as a data interface for the INS information provided by the LN-100GT navigation system to the KS-146B reconnaissance pod system. LOROP was designed to take high-resolution photographs at high altitudes and long distances. The system includes the KS-146 cameras featuring a seven-element, 1676-mm (66-inch) focal length f/5.6 lens, a two-axis gyro-stabilized scan head, a passive isolation system, and a self-contained thermal system. Depending on the altitude of the aircraft, the system can provide maximum resolution at a distance of 65 to 100 km from the target.

"Şimşek (Lightning)" Modernization Program

Modernization activities continued with the "Lightning (Şimşek) Project." The Second Package of the F-4E Lightning Modernization Project was started in 2006 to strengthen the airframe structure and improve the avionics of the 16 F-4E Phantom II Fighter-Bomber planes in the Turkish Air Force inventory. In this context, the F-4E/TM (classified as such after modernization) aircraft 68-0403, which performed its first official test flight on December 24, 2009, after its modernization, was delivered to the 1st Main Jet Base Command with a ceremony held at the 1st Air Supply and Maintenance Center (HİBM) on March 2, 2010, and the project was completed in 2010.F-4E /TM planes were undergone a similar avionic modernization to RF-4E/M reconnaissance aircraft (except the MIKES product AN/ALQ-178[V]3R passive EW suite). Within this framework, the navigation system of the plane was upgraded with the LN-100G Embedded INS/GPS produced under license by Aselsan. Plus, the Flight Controls of the aircraft was improved with the CDU-900 Control Display Unit and the Operational Flight Software developed by Aselsan engineers. With the encrypted and Link-11 compatible MXF-484 radio system that enables communication in UHF and VHF bands, F-4E/TM aircraft were provided with an efficient and secure communication capability. Similar to the Işık (Light) Project, communication between the upgraded avionics with digital interfaces such as the LN-100GT system and the and the original analog display systems maintained on the aircraft is provided through the SBU-100 Synchro-to-digital Converter Unit designed by Aselsan. Therefore, analog systems were guaranteed to work together with modern digital systems without making any changes to the existing displays that the pilots are accustomed to. Before the flight test, the new avionic systems to be integrated into the aircraft were first ground tested in the System Integration Laboratory (SEL), which was established under the 1st HİBM Command as a functional example of aircraft avionics architecture in a laboratory environment. Within the scope of the project, to measure more than 120 parameters on the F-4E/TM aircraft, Flight Test Measurement studies on the plane were carried out at the Flight Test Measurement Center under the 1st HİBM Command. This center formes the core of the 401st Test Squadron.

Conclusion

During its 46-year adventure in Turkey, which started on August 30, 1974, Phantoms served in nine different squadrons (111,112,113,131,132,171,172,173, and 401) and introduced the Turkish Air Force to modern radar, ECM and ammunition. In addition to working with advanced weapon systems, Phantoms had another significant contribution; thanks to the Terminator, Işık (Light) and Şimşek (Lightning) modernization projects, the Turkish Air Force and Turkish Defence Industry gained unprecedented experience in system integration, product development, and their testing procedures. When the project first started, Phantoms were planned to be retired in 2020 with the arrival of the first F-35 to Turkey and the reactivation of the 172nd Squadron. However, it's all water under the bridge now; the F-35s did not arrive, and the F-4E/2020s will continue to protect Anatolian skies in the future...

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