IGOR I SIKORSKY HISTORICAL ARCHIVES

Sikorsky Archives News

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Sikorsky's Shooters – Evolution of the Armed Helicopter

The U.S. Army mounted rocket launchers on the S-55 (H 19) in early weapons trials. (Sikorsky Archives)

Igor Sikorsky valued the life-saving potential of the helicopter above all. However, military users quickly understood the flexibility and firepower of rotary wing platforms and ultimately evolved highly integrated weapons systems ready to protect themselves and others. In 1951 U.S. Marine Corps Helicopter squadron HMR–161 first used Sikorsky S-55s (HRS-1s) in Korea to give fire support to troops on the ground. Operation *Bushbeater* used one helicopter to deploy riflemen on foot while Marines in a second helicopter provided covering fire from the air. Crew-served guns protected S-61s and S-65s (H-3s and H-53s) on combat rescues during the Vietnam war, and they remain part of the defensive suite on today's S-70s (H-60s). More integrated sensors and weapons have meanwhile broadened helicopter missions. MH-60R/S Seahawks can now use multi-spectral electro-optics to aim forward-firing guns and laser-guided rockets and missiles at swarming terrorist boats. The latest Romeos can combine radar and sonar plots to launch torpedoes on stealthy submarines. International Naval Hawks use radar and electronic support measures to target anti-ship missiles.

Arming helicopters began piecemeal. In July 1958, Sikorsky News told of Project AMMO, a two-day Army demonstration at Fort Bliss, Texas, and White Sands, New Mexico attended by Sikorsky general manager Lee Johnson and engineering manager Michael Gluhareff.

Two Sikorsky S-55s and an S-58 (CH-19 Chicsaws and a CH-34 Choctaw) fired 0.30 and .50 calliber guns and 2.75 in. unguided rockets at low altitude to suppress make-believe ground fire. The U.S. Marines launched a radio-guided Bullpup missile from an S-58 (HUS-1) in 1960. Royal Navy Marines armed the British-built S-58 (Westland Wessex) with wire-guided SS-11 missiles in 1963.

The Army also armed the S-58/CH-34 with rockets for aerial firepower demonstrations. (Sikorsky Archives)

Visit us at **Sikorskyarchives.com** Contact us at **iisha@snet.net** 203.386.4356

Dear Members,

It is again a sincere honor to thank our members, donors and volunteers for your support for the Igor I. Sikorsky Historical Archives in 2018 and to wish everyone a very happy and healthy New Year.

May 25, 2019 will mark Igor Sikorsky's 130th birthday. We will continue to celebrate his achievements and to preserve the legacy of this giant of a man and world-renowned aviation pioneer.

It is in this spirit that the Archives continues to preserve and promote Igor Sikorsky's many accomplishments and those of his companies through this quarterly newsletter. We respond to worldwide queries, provide presentations to local communities and organizations and participate in events celebrating the name Sikorsky.

We are particularly thankful for the excellent support that the Lockheed Martin/Sikorsky management team has provided us last year. The corporation honored our grant request, allowing us to continue our mission.

The Archives marked two major events in 2018:We are no longer located in the Barrett House, and we have established a pathway to our future with additional volunteer archivists. First, the home for the Archives since our inception no longer exists. Unrepairable structural damage forced Sikorsky to demolish the structure. All of our archival material is safely stored off-site, and we are operating out of the one time reception center. This relocation hampers our mission, but, due to our digitization efforts over the last few years, we are still able to access most of our material in real-time. Considering the long term solution, we are exploring a relocation and collaborative agreement with the University of New Haven (UNH) on the West Haven campus.

Second, largely through the efforts of Sikorsky president Dan Schultz and our Board member and Sikorsky V.P. of Engineering, Mike Ambrose, we have seen an influx of individuals willing to volunteer in support to our archival mission. It is my firm belief that this will result not only in the continued preservation of our materials but will help ensure the future of the Archives.

Preserving "The Life and Legacy of Igor Sikorsky" is a proud undertaking, and I again express my appreciation for your continued interest and support.

Dan Libertino
President

U.S. Army air mobility in Vietnam relied heavily on slow Huey Hog gunships. In 1964, the service issued a requirement for a fast, new Advanced Aerial Fire Support System (AAFSS). Sikorsky and Lockheed beat 10 industry competitors to advance AAFSS from project definition to development. In preliminary studies, Sikorsky considered both tilt-wing and tilt-propeller designs, but like Lockheed proposed a compound helicopter, the S-66.

The S-66 compound helicopter used a swiveling rotoprop to attain its high speeds. (Sikorsky Archives)

More than 300 Sikorsky engineers worked on the AAFSS proposal submitted in September 1964. Like the Lockheed CL-840 Cheyenne, the Sikorsky S-66 was a single-engine helicopter with tandem crew seats and a fixed lifting wing to unload the main rotor and carry rockets and wire-guided TOW missiles. However, while Lockheed adopted a hingeless rotor and dedicated tail propeller for its high speed AAFSS, Sikorsky integrated an articulated "flex-rotor" with a pivoting Rotoprop thruster. The Rotoprop would act as an anti-torque rotor in hover or low-speed flight but swiveled 90 degrees for forward thrust and high speed.

The S-66 was designed to integrate guns, rockets, and wire-guided missiles with optical sensors. An S-61A with AAFSS-type sight fired machine guns on a range near Burlington, Vermont in February 1965. The same helicopter later was equipped with a Rotoprop for testing. Another S-61A became the S-61F with wings and auxiliary jet engines to generate high-speed compound helicopter data. It reached 204 kt in 1965.

The Rotoprop was installed on a S-61 testbed and could pivot to the left for anti-torque control or AFT for high speed thrust. (Sikorsky Archives)

Blackhawk to Black Hawk

Lockheed won the AAFSS competition and flew the Cheyenne in 1967, but technical and cost issues killed production plans in April 1969. S-66 program manager John McKenna became Sikorsky vice president for air transportation systems and championed the S-67 solution to the high-speed armed helicopter requirement.

Design of the S-67 Blackhawk began on November 20,1969, and first flight came just nine months later. Hand-made in the Stratford development shop from red-lined drawings, the streamlined, tandem-seat Blackhawk used an S-61 rotor system and drivetrain and the General Electric T58-GE-5 engines and 11 ft diameter tail rotor of the Air Force S-61R. In September 1970, Sikorsky News reported "more than 250 representatives of United States and foreign governments and the news media attended a flight demonstration and briefing on the new S-67 Blackhawk helicopter at Sikorsky's Stratford plant." The handsome demonstrator flew at 167 knots and pulled a 2.65 G turn before the crowd. "Spectators were impressed with the low sound levels of the new helicopter."

The S-67 Blackhawk attempted to answer the AAFSS requirements after the Cheyenne cancellation. (Sikorsky Archives)

The Blackhawk was originally built to fly just 10 hours and top 200 kt to prove compound helicopter technology, but it went on an extended marketing tour to Fort Bragg, North Carolina; Fort Stewart, Georgia; Pensacola, Florida; Killeen, Texas; Fort Sill, Oklahoma; Fort Leavenworth, Kansas, and Dayton, Ohio. Test pilot John Dixson recalled, "The whole purpose of the trip was to generate interest within the Army. The idea was to fly people at every location. We got everybody and anybody into that aircraft." Sikorsky test pilots routinely rolled the big attack helicopter, and Army officers flew fighter-like Split-S maneuvers. "It was very easy to fly. It was very stable. You could put it in a dive and it would stay on point. It was easy to aim." The S-67 automatic flight control system borrowed from the S-64 (CH-54B) was never activated, but a force feedback mechanism gave pilots tactile cues of aircraft limits. An inertial system from the Army's fixed-wing Mohawk drove a moving map display from the Air Force A-7 attack jet and calculated aiming points for a head-up display from the F-111 bomber. S-67 firing trials in Vermont included a 20 mm rotary cannon and rocket runs.

The Blackhawk routinely demonstrated rolls with its articulated rotor. (Sikorsky Archives)

The S-67 hit 208 kt in a shallow dive in 1970 and set a world helicopter speed record at 192 kt on a closed course in 1971. (A ducted tail rotor tried in 1973 failed to provide expected drag reductions.) The fast new Blackhawk had airbrakes on its wings that enabled the diving helicopter to stay on target longer.

The U.S. Army Aviation Systems Test Activity at Edwards Air Force Base, California, compared the S-67 favorably to the Bell KingCobra and a propeller-less Cheyenne. On a 1972 international tour, the Blackhawk flew with guest pilots including German fighter ace Adolph Galland and was inspected by the Shah of Iran. Yet for all its promise, the S-67 found no buyer. The program was abandoned after the 1974 Farnborough Airshow as Sikorsky focused on the Utility Tactical Transport Aircraft System (UTTAS) competition.

The first S-70 (YUH-60A) UTTAS prototype flew at Stratford on October 17, 1974 with a main rotor built on a clean elastomeric hub. It was designed as a powerful, ballistically tolerant, crashworthy assault transport. The Army meanwhile formulated an Advanced Attack Helicopter (AAH) requirement around hovering, nap-of-the-earth combat to defeat integrated air defenses in Europe. Sikorsky proposed a tandem-seat S-71 with the same ballistically hardened structures and systems, twin T700-GE-700 engines, and dynamics from the S-70 Black Hawk. However, with the UTTAS competition being fought out by the Sikorsky YUH-60 and Boeing YUH-61, Army AAH

The S-71 was smaller but more powerful than the S-67 and designed to meet Advanced Attack Helicopter Requirements. (Sikorsky Archives)

leadership chose to pit the Bell YAH-63 against the Hughes YAH-64. The YAH-64 won the AAH fly-off in December, 1976 and gave the Army today's Apache attack helicopter. The S-71 remained only a mockup.

The US Army chose the Black Hawk for the UTTAS helicopter shortly after Sikorsky won the production contract on December 23,1976. UH-60As and Ls were tested by the US Army with laser-designated Hellfire missiles and Volcano mine dispensers on External Stores Support System "wings." The 160th Special Operations Aviation Regiment developed

The S-70M Black Hawk today carries a mix of qualified weapons on its External Stores Support System. (Sikorsky Archives)

the MH-60L DAP -- Direct or Defensive Action Penetrator – with Hellfire and Stinger missiles, 30 mm Chain Guns, 7.62 mm miniguns and 19-shot rocket pods. The Nightstalkers even test-fired the TV/infrared/ laser-guided Maverick missile from a Black Hawk. More S-70s were armed for international customers. Colombia, for example, flies the AH-60L Arpia with partially-digital cockpit, weather radar, electro-optical/infrared sensors, laser-guided missiles, rockets, and 0.50 caliber guns. Sikorsky collaborated on a UH-60L Battle Hawk in Israel in 2008 and 2009 but found no customer. International S-70M/S-70i operators instead sponsored an Armed Black Hawk now qualified with digital avionics and head-tracking helmet display to aim forward-firing 0.50 caliber Gatling guns, 70 mm unguided rockets, and laser-designated Hellfire missiles.

An international Black Hawk demonstrator carries Hellfire and Stinger missiles on its ESSS. (Sikorsky Archives)

Commercial to Comanche

The international market for armed multi-role helicoers put weapons on the commercial S-76. A dramatic picture in the in September 1982 Sikorsky News showed the "Armed Utility S-76 MARK II" with 20mm cannon pods undergoing weapons qualification tests in the Mojave Desert. Company president Robert

The AUH-76A had a cabin floor beam to carry TOW missiles (shown here), rockets, or guns.(Sikorsky Archives)

Daniell noted, "the MARK II proved itself a stable weapons platform, and that the Sikorsky-developed Weapons Armaments Support Pylon is an efficient, easily installed way to mount weapons on the aircraft." Two helicopters – S-76A No. 199 and S-76B No. 303 -- had stiffened cabin floors to carry the weapons beam. The articulated beam could carry one or two guns or rocket pods per side and pitched up and down to optimize rocket trajectory. A small projection sight gave the pilot aiming cues, later with the help of a laser rangefinder. The armed S-76B ultimately acquired a mast-mounted sight and co-pilot optics to aim the wire-guided TOW missile.

Sikorsky pilots flew the armed S-76A at the Paris Airshow and then across Europe to Greece, Jordan, Saudi Arabia, and South Korea. The S-76B model with TOW sight flew at Farnborough and later toured Sweden. Sikorsky later marketed the H-76 Eagle to the U.S. Army, but the only announced sale of the armed, multimission S-76 was to the Philippine Air Force in 1984 to replace fixed-wing T-28 counterinsurgency aircraft. AUH-76As saw action in Mindanao, the Visayas and Northern Luzon. The armed helicopters played a role in the 1986 revolution when they joined Philippine rebel forces.

The AUH-76B became the H-76 Eagle with Pitch Compensated Armament Pylon, shown here with mixed rocket pods. (Sikorsky Archives)

In the early 1980s, the U.S. Army in Europe faced sophisticated Soviet air defenses with Vietnam-vintage light scout and utility helicopters. An Aviation Mission Area Analysis in December 1982 shaped the Light Helicopter Experimental - LHX - that evolved into the stealthy and highly integrated RAH-66 Comanche. Sikorsky and Boeing formed their First Team in June 1985 and flew the first of two tandem-seat scout-attack helicopters on January 4 1996. The Comanche drew on fly-by-wire (FBW) flight controls, a five-bladed bearlingless main rotor, and ducted Fantail to achieve speed, agility, and a low noise signature. FBW control laws made maneuvers sharper and smoother, and tied into weapons solutions generated in shoebox-sized core computer clusters. An Electro Optical Sighting System and mast-mounted fire control radar would have provided cues for Aided Target Recognition to help pilots sort out threats on a target-rich battlefield.The Army chose not to tie the Light Helicopter to the development of new weapons. Comanche I-RAMS (Integrated Retractable Aircraft Munitions

The RAH-66 Comanche packed weapons in a Low Observable helicopter with a highly integrated avionics architecture. (Sikorsky Archives)

System) bays were sized for familiar Hellfire anti-tank and Stinger air-to-air missiles. Each bay had three hardpoints for a single Hellfire, two Stingers, or a four-shot rocket pod. The three-barreled 20 mm cannon could swing in and out of its Low Observable fairing in two seconds and fire 750 rounds per minute at ground targets or 1,500 rpm in air-to-air combat. When stealth was not an issue, the Comanche Enhanced Fuel and Armament Management System (EFAMS) could hike the mixed weapons load to 13 Hellfires, two Stingers, and 500 rounds of 20 mm ammunition.

The S-97 Raider compound helicopter is sized for the scout-attack mission. (Sikorsky Archives)

For all its planned lethality and demonstrated handling qualities, the protracted RAH-66 was canceled in 2004 as Army budgets addressed the Global War On Terror. The Army is again looking for an armed scout to play "digital quarterback" on a networked battlefield.

Sikorsky delivered its proposal for a Future Attack Reconnaissance Aircraft (FARA) Competitive Prototype to the U.S. Army in December 2018. The optionally-manned FARA aims to be an agile, compact, networked "knife-fighter," a new armed scout to breach enemy air defenses and protect troops on the ground.

Independent of FARA, Sikorsky's S-97 Raider compound helicopter has so far topped 200 kt and can revolutionize rotary-wing attack profiles.

The Raider capitalizes on Sikorsky X2 tecnologies — a rigid coaxial rotor system, integrated auxiliary thruster, Fly-By-Wire flight controls, and active vibration suppression. More than a speedy, agile platform, the armed helicopter today is a networked system-of-systems built on Sikorsky integration expertise augmented by that of Lockheet Martin.

The latest MH-60R can use its electro-optical sensors to target laser-designated Hellfire missles. (Sikorsky Archives)

The International Naval Hawk integrates radar with Electronic Support Measures to target Penguin anti-ship missles. (Sikorsky Archives)

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The Sikorsky family (Igor III, Sergei, Nickolai and Igor Jr.) at the release of the Two Roads Brewery's 2019 edition of 'Igor's Dream – Russian Imperial Stout' – January 26, 2019

Prepared by Frank Colucci and John Bulakowski with graphic art and layout by Jodi Buckley.

"The helicopter has demonstrated with great success its ability to fulfill virtually every type of mission expected of it plus numerous other services which even the most ardent enthusiasts were unable to forsee"

Igor Sikorsky

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