Sikorsky Archives News

Published by the Igor I. Sikorsky Historical Archives, Inc. M/S S578A, 6900 Main St., Stratford CT 06615

THE SIKORSKY QUEST FOR SPEED

TRAC

Stowed Rotor

CARA

S-61F

S-67 Blackhawk

RSRA

X WING

ABC

X2

Igor I. Sikorsky Historical Archives, Inc.

(203) 386-4356 | (203) 386-4218

January 2009

Visit us at Sikorskyarchives.com

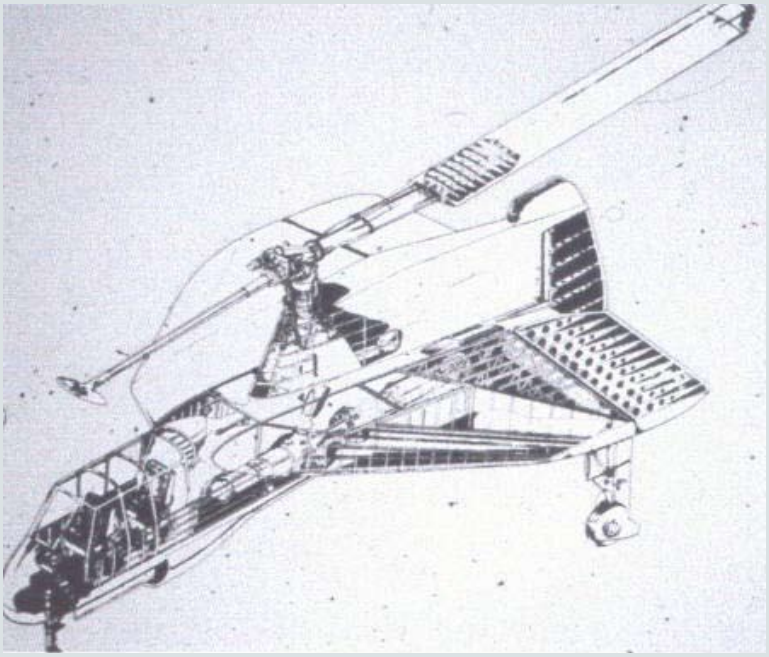
Contact us at iisha@snet.net

CONVERTIPLANES

In the late 1940's, the helicopter had proven itself, and numerous aircraft were in production. Conventional helicopters are speed limited to about 180 knots. Toward the goal of achieving speeds beyond the 180 knot limitations, Sikorsky convertiplane studies were initiated in 1949 with the S-57 configuration. The convertiplane was an aircraft configuration that combined the vertical take off features of the helicopter and the forward flight and range characteristics with the fixed wing aircraft.

The Sikorsky S-57 stowable rotor convertiplane design was developed during the 1951 to 1954 time period. The final design was a jet powered airplane with a one bladed, counterbalanced, pressure jet rotor which could be stopped and started in flight. U.S. Air Force contracts supported the design studies and scaled model wind tunnel testing, which included studies of the stowable rotor concept.

The early research and development of these concepts was severely hampered by limited turbine engine technology. Rotor system drive was limited to the cold cycle gas propulsion technology. Both dart and conventional tapered trapezoidal wing configurations were wind tunnel tested. Issues with flight loads and the dynamics of stopping and starting the single bladed rotor in flight were never resolved, and the program was teminated.



S-57 Single Bladed Convertiplane Design

S-57 with Dart Wing

.

The U.S. Air Force sponsored a program from May 1955 to April 1958 to design and wind tunnel test a two bladed stowed rotor design. A 10 foot diameter two bladed rotor was designed and fabricated for wind tunnel testing. The design incorporated a stowing feature to permit the blades to fold back along the aircraft's longitudinal axis. The program was discontinued in 1958 when it was 80% complete due to other Air Force priorities.

Two Bladed Stowed Rotor

In 1963, design work on an improved stowed rotor concept was resumed with the development of new light weight turbines and smaller rotor diameters, which resulted in simplifying both rotor hub structure and stowing mechanism.

Four Bladed Stowed Rotor

Combat Aircrew Recovery Aircraft

In the mid sixties the Air Force Aerospace Rescue and Recovery Service had a requirement for a long range hovering aircraft for rescue of downed flight crews. The CARA (Combat Aircrew Recovery Aircraft) program was created. Sikorsky teamed with North American Aviation and proposed a Stowed Rotor concept for this mission. The combination of the development time and cost for any of the proposed aircraft plus the desire for a near term solution, resulted in the Air Force not proceeding with the program. Sikorsky terminated active work on stowed rotor aircraft design.

COMPOUND HELICOPTERS

These aircraft added auxiliary lift and forward propulsion devices to conventional helicopters. Sikorsky's design for a compound helicopter was the NH3A/S-61F. This was a modification of an SH-3A Navy aircraft, and was developed under a U.S. Navy, U.S. Army and Sikorsky contract. It added a 170 sq. ft. fixed wing, with 32 ft. span, a new 8.05 sq. ft. horizontal tail, and two Pratt & Whitney J-60-P2 jet engines (2,900 pounds thrust each) for auxiliary thrust. It first flew on May 21, 1965 in the helicopter configuration. The S-61F achieved speeds of 210 knots, and 230 knots with variations in configurations. The flight test program was completed on May 8, 1967 after 113 flights and over 88 flight test hours.

NH-3/S-61F Compound Helicopter

Telescoping Rotor AirCraft

The Telescoping Rotor AirCraft (TRAC) concept reduced the diameter of the rotor in high speed flight to alleviate aerodynamic and dynamic issues. Tests included wind tunnel tests of rotors using a ball screw mechanism to reduce span of the blade diameter. The complexity and weight of the required mechanisms had to be traded off against the advantages obtained.

In the mid 1960s, the U.S. Army developed a need for a higher speed aircraft for use as the Advanced Aerial Fire Support System (AAFSS) to replace the Bell AH-1s. The AAFSS design speed was 260 knots. Sikorsky proposed the S-66 compound helicopter vs the Lockheed XH-51A Rigid Rotor. The Army selected Lockheed. History has shown that the Lockheed Rigid Rotor was unsuccessful, and their contract was terminated

S-66 AFFSS

ROTOPROP DEVELOPMENT

Sikorsky built and flight tested the Roto-prop concept on an S-61A . A conventional tail rotor was mounted on the tail pylon and swivelled 90 degrees to become a propeller. Conversions were accomplished by the pilot control in about three seconds.

S-61A Rotoprop Demonstrator

S-67 BLACKHAWK DEVELOPMENT

As the Lockheed Cheyene XH-51(Rigid Rotor) aircraft development proceeded, Sikorsky built under company funds the S-67 Blackhawk (not to be confused with the UH-60 Black Hawk). The S-67 consisted of an all new narrow tandem two pilot fuselage combined with the dynamic system from the H-3 production helicopter. It included a wing and drag brakes. The aircraft was fast and highly maneuverable. In 1970 it set a speed record (188 knots) for helicopters without auxiliary propulsion.

S-67 Blackhawk

The S-67 Blackhawk was used as a flight test vehicle for a fan-in-fin anti-torque system to replace the conventional tail rotor. This provided data for future aircraft designs. The flight test data aided in establishing the design criteria for the RAH-66 Comanche, developed many years later.

S-67 Fan-in-Fin

ROTOR SYSTEMS RESEARCH AIRCRAFT (RSRA)

NASA and the U.S. Army selected Sikorsky in 1973 to develop a compound helicopter for an extensive rotor systems research program, which was completed in 1979. Two aircraft were delivered to the NASA Ames in 1979 for continued research with Sikorsky assistance. Systems included:

-Low mounted variable incident wing
-Two TF-34 engines for auxiliary propulsion
-Main transmission mounted on force/moment rotor measurement system
-Rotor vibration isolation system
-Pilot fly-by-wire flight control system
-Crew extraction system
-300 knot fuselage with drag brakes
-SH-3/S-61 drive system

RSRA in Helicopter Configuration

RSRA in Airplane Configuration

THE X-WING AIRCRAFT

X Wing

X Wing Rotor on RSRA

In 1982, the Defense Advanced Research Projects Agency (DARPA), U.S. Navy and NASA selected Sikorsky for a large scale flight test of the X-Wing concept utilizing the RSRA flight test aircraft. The X-wing concept employs circulation control airfoils permitting the rotor/wing to stop in flight and become a fixed X-wing. The goal was to achieve a design speed of 450 knots.

The X-Wing technical challenges included:

-Large composite complex blade/wings using leading and trailing edge blowing to control lift during all flight modes.
-High frequency electronic flight controls including higher harmonic control
-48 mechanical valves in place of the conventional mechanical swashplate
-Large compressor to provide the circulation control air
-Large mechanical brake for stopping the rotor

Roll-out of X-Wing installed on RSRA occurred August 19, 1986. A tremendous amount of technical challenges had been resolved in five years. However, there were still technical risks remaining and the government decided to terminate the contract.

THE ADVANCING BLADE CONCEPT

Sikorsky created the Advancing Blade Concept (ABC) in the mid 1960s as an alternative to the compound helicopter. The basic goal was to eliminate the problem of the retreating blade stall by using two counter-rotating rotors so that there were advancing blades on both sides of the aircraft.

In 1972, the U.S. Army contracted with Sikorsky for the design, fabrication and flight testing of two XH-59A ABC demonstrator aircraft. Rotor power was provided by a Pratt & Whitney PT-6T-3 Twinpack engine. Auxiliary propulsion was provided by two Pratt & Whitney J60-P-3A engines one, on each side of the fuselage. The XH-59A used two 3 bladed titanium spar 36 ft. diameter rotors.

An extensive flight test program was accomplished from 1973 through 1981. A maximum speed of 240 knots in level flight, and 263 knots in a shallow dive was achieved. The U. S. Army stopped its formal participation in the program in May, 1981. An improved version the XH-59B was proposed as a follow on program, but was not funded.

XH-59A

XH-59B

Igor Sikorsky and his H-2 Coaxial helicopter in 1910

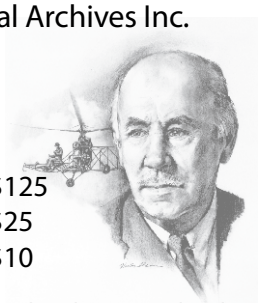
Igor Sikorsky Creates the First Practical Single Rotor Helicopter in 1939

Sikorsky Aircraft Creates the X2 High Speed Helicopter of the Future in 2008

The data for this newsletter was obtained from the paper written by Arthur Linden, "Fifty Years of Sikorsky High Speed Concepts", presented at the American Helicopter Society 64th Annual Forum, 2008. Arthur Linden retired from Sikorsky Aircraft in 2000 as the Boeing Sikorsky Program Director. He had a distinguished career in the preliminary design and research and development areas, and was instrumental in developing advanced technologies.

Join the Sikorsky Archives

Igor I. Sikorsky Historical Archives Inc.
MS S 578A
6900 Main Street
Stratford, CT 06615-9129



Life Membership	$125
3 Year Membership	$25
1 Year Membership	$10

Please send a check or money order (do not send cash) payable to The Igor I. Sikorsky Historical Archives, Inc.

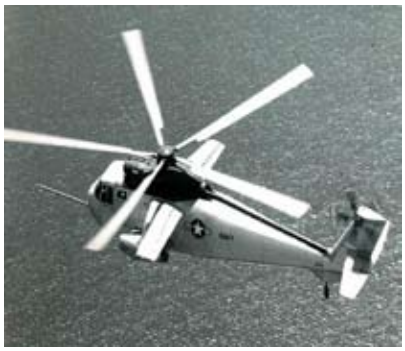
Name _____

Address _____

City _____

State _____ Zip _____

Phone Number(s) _____



Newsletter designed and edited by Lee Jacobson, Art Linden and Edgar Guzman.

"I started my activities in aviation by building a helicopter in 1909, with a small Anzani 25 hp engine with two crude propellers rotating in opposite directions on concentric shafts. This first machine achieved little results except mainly to teach me how things should not be done."

Igor I. Sikorsky

Sikorsky Archives News
M/S S578 6900 Main Street, Stratford CT 06615