Sikorsky
Flying The Future
X2 Technology™ and the
Future of Vertical Lift

October 2020

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INTRODUCTION

• Our background
• Topics for the talk
  – History of X2 Technology™
  – Why X2?
  – Where have we been recently?
  – Where are we going?
FROM HUMBLE BEGINNINGS

BUT BOLD NONE THE LESS!
IGOR SIKORSKY VS-300 (MAY 20, 1940)
TO A FUTURE REIMAGINED
TRANSFORMATION HAS BEEN A THEME
S-69 ADVANCING BLADE CONCEPT

First Flight Aug 1973
240 knots S&L, 263 Dive
Retired 1981

MGW 9,000 lb (Helicopter)
MGW 11,000 lb (Compound)

High Vibration
High Pilot Work Load
Low Propulsive Efficiency
High Rotor Drag
X2 TECHNOLOGY™ DEMONSTRATOR

First Flight 2008
MGW 6,000 lb
250 knots S&L (Sep 2010)
263 knots Dive

17 flights to 250 knots 17 hours
23 flights total 20.2 hours
100th Collier Trophy Award Winner 2011
X2 TECHNOLOGY™ DEMONSTRATORS
SB>1 DEFIANT®
## SIKORSKY LEADING THE WAY TO FUTURE VERTICAL LIFT

<table>
<thead>
<tr>
<th>Year</th>
<th>Event</th>
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<tbody>
<tr>
<td>2011</td>
<td>X2 TECHNOLOGY™ DEMO - X2 Last Flight</td>
</tr>
<tr>
<td>2015</td>
<td>S-97 RAIDER® - S-97 Raider 1st Flight</td>
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<tr>
<td>2018</td>
<td>FARA Proposal</td>
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<td>FARA 5-2 Down select 2020</td>
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**DEFIANT®**

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<td>FVL Medium Analysis of Alternatives</td>
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**S-97 RAIDER®**

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**FLRAA**

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WHY X2 TECHNOLOGY™?

• The threat is evolving quickly, we must revolutionize to stay ahead

• Future battles will demand higher speed, higher maneuverability, improved survivability and lower sustainment costs

• X2 Technology™ provides exceptional improvements over Single Main Rotor (SMR) solutions, SMR is operating at upper limits already (180kts) with very limited growth potential

• Reduced vulnerability with elimination of flight critical tail rotor

• Reduced acoustic signature in helicopter mode

• Level body acceleration and deceleration, attitude control in hover provides much improved SA

• Significantly improved handling qualities and very easy to fly

• Redefines CONOPS on how aircraft used in battle

• Designed for sustainment with model based design and condition monitoring throughout aircraft
FROM PAPER TO FLIGHT
COMPREHENSIVE TESTING AND TOOL CORRELATION

Technology Maturation & Risk Reduction

NASA NFAC 40’x80’ Wind Tunnel

Powered System Test Bed (PSTB)

Flight Article

Systems Integration Lab (SIL)

Component Ground Tests

Modeling and Tool Correlation

Operations Analysis

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WIND TUNNEL TESTING

- 400+ hours Wind Tunnel Testing including the National Full-scale Aerodynamics Complex (NFAC)
- Independent balances for each rotor and prop
- Single rotor, dual rotor, interactional aero testing
- Fastest edgewise rotor ever tested in NFAC (250 kts)
GROUND TEST

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SYSTEM INTEGRATION LAB (SIL) TESTING

- Pilot in the loop
- All fly-by-wire control system components (“wet SIL”)
- Motion base simulators
TRANSMISSION SYSTEM TEST BED (TSTB) – RAIDER®
## S-97 RAIDER® PROTOTYPE SUMMARY

### Weights
- **Empty Weight**: 7,900 lb
- **3.5 g Design Gross Weight**: 8,900 lb
- **Maximum Gross Weight**: 11,400 lb

### Fuel (196 gal)
- **Fuel**: 1,300 lb

### Rotor
- **Main Rotor Diameter**: 34.0 ft

### Propeller
- **Number of Blades**: 6
- **Diameter**: 7.0 ft

### Engine (1 x YT-706)
- **Power (SLS, ISA, T/O)**: 2,600 hp

### Transmission
- **Main Rotor (5 minute rating)**: 1,900 hp
- **Propeller Continuous**: 2,000 hp

### Performance (Armed) (20 min RSV, 6000 ft, 95°F)
- **Endurance (std fuel)**: 2.7 hr
- **Range (std fuel, 200 KTAS)**: 650 km / 351 nm

### Cruise Airspeeds
- **With Armament**
  - **Maximum Cruise Speed \( (V_{MCP}) \)**: 220 KTAS
- **Without Armament**
  - **Maximum Cruise Speed \( (V_{MCP}) \)**: 220+ KTAS
  - **Dash Speed (30-min)**: 230+ KTAS
S-97 RAIDER® CONFIGURATION

- Rigid Coaxial Rotor System
- GE YT 706 Engine (Growth to ITEP Engine)
- UH-60 Hydraulics and Electrical
- Conventional Transmission Technology
- Composite Airframe
- Cabin For 6 Troops
- Retractable Landing Gear
- Propeller and Clutch-Conventional Technology
- Weapons Provisions

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S-97 RAIDER® PERFORMANCE TARGETS

- 220 knots
- Armed

- 6 x 320 lb Troops
- 6K/95°F

- 2.7 hrs
- Endurance

- 3.0 g
- Maneuverability

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RAIDER® FLIGHT TEST
• 128 flights / 90 flight hours
• 207 knots forward speed
• 215 knots shallow decent
• Turn Coordination
  – 60 degrees AOB at 160 knots
• Pull-ups at forward speed
  – 2 g pull-ups while entering 60 degree AOB turns
• Left and Right Side flight up to 35 knots
• Nose pointing hanging on prop
• Yaw Rate 30 Degrees/Sec
• ADS-33 Low Speed Maneuverability Course
• Acoustic Testing
AND THE FUTURE
RAIDER X™