

Army Decides on FARA and FLRAA

The US Army's downselections in March narrow the field and advances its two FVL programs.

By Mike Hirschberg, VFS Executive Director

On March 16, the US Army announced that it had awarded Competitive Demonstration and Risk Reduction (CDRR) agreements to Bell and Sikorsky-Boeing for its Future Long Range Assault Aircraft (FLRAA) program. Nine days later, on March 25, the Army selected Bell and Sikorsky to continue into phase two of the Future Attack and Reconnaissance Aircraft (FARA) Competitive Prototype (CP) program. Both programs are part of the broader US Department of Defence (DoD) Future Vertical Lift (FVL) effort.

FLRAA

The seeds for a comprehensive initiative to replace DoD-wide legacy helicopters with next-generation rotorcraft were planted (partly at the behest of VFS) in January 2008 when the US Congress directed the Pentagon to initiate an FVL Capabilities Based Assessment (see www.vtol.org/FVL for past *Vertiflite* articles and other resources).

After internal studies in 2009-10, the Army awarded "Phase 0" Configuration Trades and Analysis Technology Investment Agreements (TIAs) to AVX Aircraft, Bell Boeing, Boeing and Sikorsky in mid-2011, followed in October 2013 by awards for initial Joint Multi-Role Technology Demonstrator (JMR-TD) Phase 1 design to AVX, Bell, Karem Aircraft and Sikorsky-Boeing.

In August 2014, the Army downselected to Bell and Sikorsky-Boeing to build flying demonstrators for the JMR-TD phase. Both teams received around \$100M to support their JMR aircraft development; it's believed that each team contributed another \$300-400M to fund the development and flight testing. AVX and Karem were funded at a lower level to continue non-flying risk reduction activities under the JMR-TD.

The Bell V-280 Valor was first in the air in December 2017, with the Sikorsky-Boeing SB>1 finally getting airborne in March 2019.

AVX conducted subscale wind tunnel testing of its Compound Coaxial Helicopter (CCH), while Karem built a full-scale rotor, nacelle and test stand for its optimum speed tiltrotor (OSTR) concept. Karem's 36-ft (11-m) diameter, single-rotor tiedown (SRT) testing demonstrated its suite of proposed OSTR technologies.

On Dec. 11, Bell conducted a demonstration at its Arlington, Texas, Flight Research Center (FRC) for members of the media. VFS attended as well and posted photos in the Vertical Flight Photo Gallery www.gallery.vtol.org. The V-280 demonstrated high-speed flight and low-speed maneuverability.



■ Bell V-280 Valor in Arlington, Texas. (VFS)

The company repeated the demonstration on Jan. 10 for the media and this time also with Army Secretary Ryan McCarthy; Rep. Kay Granger (R-Texas), the ranking member of the powerful House Appropriations Committee (HAC); Maj. Gen. Thomas Todd, the Army's then-Program Executive Officer (PEO) for Aviation; and Brig. Gen. Walter Rugen, director of the FVL cross-functional team. By March, the aircraft had completed some 170 hours of flight testing.

The Sikorsky-Boeing team held a similar media-government demonstration the next month, on Feb. 20, at Sikorsky's Development Flight Center (DFC) in West Palm Beach, Florida. Senior government leaders included Army Secretary McCarthy; Sen. Tammy Duckworth (D-Illinois), a member of the Senate Armed Services Committee (SASC); Mr. Patrick Mason, the current PEO Aviation; and Brig. Gen. Rugen.



■ The Defiant and Raider were together for the first time in public on Feb. 20. (VFS photo)

VFS and media representatives received detailed walk-around briefings the day prior on the SB>1 Defiant, as well as the Sikorsky S-97 Raider and the Sikorsky Autonomy Research Aircraft (SARA) with the company's MATRIX Technology. A gallery of walkaround photos of all three aircraft — along with the UH-60A Optionally Piloted Vehicle (OPV) Black Hawk and the Defiant Propulsion System Test Bed (PSTP) — are also posted in the VFS Gallery, as well as a gallery of the three aircraft in flight.

Although they weren't airborne simultaneously, this was the first time that the FARA and FLRAA demonstrators appeared together in public.



Igor Cherepinsky shows Sen. Duckworth how to fly SARA. (VFS)

Igor Cherepinsky, the director of autonomy programs at Sikorsky, assisted Senator Duckworth and Secretary McCarthy in controlling SARA from the ground with a tablet computer.

Duckworth, a former US Army lieutenant colonel and UH-60 pilot, is a double-amputee as a result of a crash when her Black Hawk was hit by a rocket-propelled grenade in Iraq. She made poignant comments about the need for speed and survivability for next-generation rotorcraft: "I got shot down flying 10 ft [3 m] above the trees going 100 kt [185 km/h]. We're going to be able to protect our warfighters from that so they can go out and fight another day." She also highlighted the long-range requirements for potential operations in the Pacific.

"I'm going to make sure that I'm the champion for Future Vertical Lift and Army Aviation as long as I'm in the Senate," she promised.

The Sikorsky-Boeing team received \$97M and Bell \$84M to refine their FLRAA designs further in the CDRR phase, which will last until late 2021; then, one of the two designs will be downselected for the FLRAA development program of record, estimated at \$4.5B. The prototype of the chosen FLRAA design is expected to fly in 2024, and an initial operational capability (IOC) with the Army in 2030.



AVX teamed with L3Harris for the FARA competition. (AVX)

FARA

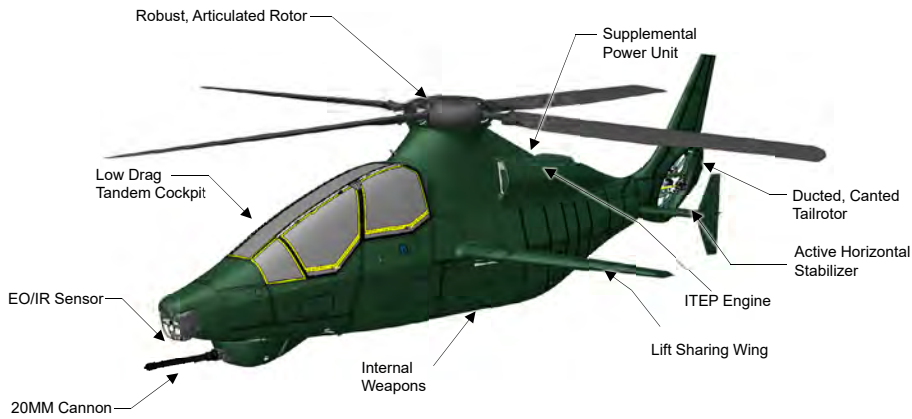
The history of FARA is much shorter. It was announced with FLRAA in March 2018 (see www.vtol.org/FARA), as somewhat of a surprise. For the first decade of FVL, the Army had been focused on the medium-class and the JMR-TD was aligned with that need. The smaller, scout/light attack capability set had been planned to follow FLRAA.

However, with the Army's retirement of its OH-58D Kiowa Warrior fleet in 2013 and the growing proliferation of anti-aircraft defenses, the Army decided to prioritize the timeline of the stealthy FARA program with an IOC of 2028. According to the FARA solicitation, "Army Aviation must operate in highly contested/complex airspace and degraded environments against peer/near peer adversaries capable of an advanced integrated air defense system."

Seven companies submitted bids to the FARA Competitive Prototype competition in December 2018, and the Army announced four winners in April 2019 to begin the prototype designs. Some of the released requirements included a rotor diameter of no more than 40 ft (12.2 m), a cruise speed of no less than 180 kt (333 km/hr) and a dash speed of 200 kt (380 km/h) or greater. In addition, the gross weight was capped at 14,000 lb (6,350 kg).

AVX Aircraft teamed with L3Harris Technologies for a smaller version of its JMR compound, coaxial helicopter with highly integrated sensors and systems.

Bell designed its tandem-seat 360 Invictus helicopter with a four-bladed main rotor and a shrouded tail fan driven by a second engine serving as a supplementary power unit.



High performance main rotor, lift-sharing wing, and SPU provides all the hover/speed advantages of the coaxial compound without the complexity, weight, and vibration

Bell designed its 360 Invictus for simplicity and affordability. (Bell)

Boeing remained mum on its concept during the entire FARA competition until it inexplicably unveiled its design on March 3, three weeks before the Army announced that it had been rejected. The Boeing FARA design featured a six-bladed main rotor, a conventional four-bladed tail rotor and a four-bladed pusher propeller.

Karem Aircraft, teamed with Northrop Grumman and Raytheon, offered its AR40 compound helicopter, with a tilting wing and a pivoting tail rotor that could provide either anti-torque or forward thrust for high-speed flight.



The Sikorsky Raider X is nearly 25% heavier than the S-97 Raider. (Sikorsky)

Sikorsky's 11,000-lb (5.5-t) S-97 Raider was scaled up as its Raider X for the larger and slightly slower FARA. At the Feb. 19 media tour in Florida, Tim Malia, Sikorsky's FARA director, said that the company had already begun construction of Raider X for FARA in advance of the downselection. Presumably, Bell or other competitors may have done the same.

Perspective

The Army's decisions in March eliminated two companies — AVX and Karem — that had been competitors in FVL for the better part of a decade.

"AVX/L3Harris and our team of suppliers were strong competitors for the FARA CP Phase 2 program," stated AVX Chief Operating Officer Kendall Goodman. "The Coaxial Compound Helicopter design is fundamentally sound and will gain momentum with other commercial and military customers."

Karem's Director of Military VTOL Business Development Bruce Tenney stated that the company has "a great design for FARA that we believe offers unmatched performance and brought a new and exceptionally capable team to the rotorcraft community. We were excited and privileged to participate in the FARA Phase 1 program and were enthusiastic about building and demonstrating a prototype of our game changing aircraft for the Army in Phase 2. We wish the Army well as they pursue the rest of the program and will look for opportunities to contribute to its eventual success."

Regarding FLRAA, Tenney said, "Similarly, we are disappointed to not be part of the continuing effort on the FLRAA program. The Optimum Speed Tiltrotor (OSTR) is a perfect match for the FLRAA requirements and we will endeavor to find pathways for technology insertion to help the program in any way we can." Karem has been testing their OSTR rotor since October (see sidebar).

Karem's OSTR Testing

As part of its JMR-TD activities, Karem Aircraft has been testing its full-scale, single-rotor tiedown (SRT) article since October. The company completed the majority of the initial testing at the Southern California Logistics Airport in Victorville, California before COVID-19 restrictions forced an early halt. This initial testing used a 500 hp (375 kW) electric drive, which allowed the test to vary the RPM range from zero to speeds representative of vertical takeoff and landing (VTOL), while exercising significant collective and cyclic control enabled by Karem's unique individual blade control (IBC) system.

The full nacelle was brought back to Karem's workshops in Lake Forest, California, where the company is installing the turbine engine so that when the COVID-19 restrictions are lifted, the testing can return to Victorville to complete the test program. Karem's Bruce Tenney commented that,



"Results to date have shown the technology elements to be working well and we are excited to expand the testing to high power conditions once we are able to return to test."

Karem 40-ft SRT Testing in Victorville, California. (Karem)

"We are confident that the collection of OSTR technologies offer dramatic improvements for vertical flight and are maturing them in anticipation of new development and product improvement opportunities," Tenney stated.

Goodman similarly stated that, "The AVX team embraced the spirit of small company innovation. Our talented staff of rotorcraft experts is ready for the next challenge."

"We are honored to move to the next phases of both the FARA and FLRAA programs. Our Future Vertical Lift technology will redefine the look and operation of modern military helicopters," said Sikorsky President Dan Schultz.

"The selection of the Bell 360 Invictus to continue in the FARA program builds on our decades-long legacy as an innovator in reconnaissance rotorcraft supporting the maneuver force," said Mitch Snyder, president and CEO of Bell. "Our team has applied innovative thinking with tested technology to give the Army a low-risk option to fulfill its requirements on an aggressive schedule."

Regarding FLRAA, Snyder commented, "The JMR-TD and V-280 show that rapid maturation of new technology is possible with a solid government-industry partnership fueled by our talented and innovative workforce. We look forward to the FLRAA competition."