The US Army portion of the Future Vertical Lift (FVL) initiative is intended to give the Service the reach, protection, lethality and agility impossible with today’s helicopters. In late-July, Brigadier General Walter Rugen, director of the Army’s FVL cross-functional team, made sense of FVL’s fast-moving parts at a Washington, DC-area conference organized by the Institute for Defense and Government Advancement (IDGA). The company’s first International Military Helicopter USA Summit, held July 29–31, was supported by the Vertical Flight Society and featured several VFS members as speakers.

According to Rugen, the Army has four concurrent lines of effort, competing well for resources within the Army and on Capitol Hill, that are all key parts of the services current priorities for FVL. The general explained, “It’s all about an ecosystem. If you take [away] any one of these four lines of effort, you can defeat us in detail … It takes the whole team.” With a warfighter’s pragmatism, Rugen also addressed how the Army can afford to fund simultaneous FVL developments: “We’re saying, ‘We can’t afford not to.’”

Rugen noted, “In the ’70s we designed the Black Hawk [and] the Apache; and really the Chinook was a ’50s design. We’re stuck in this incremental upgrade cycle where we can only get so much better.” Both the Apache and Black Hawk were developed near-simultaneously, with both prototypes making their first flights within a year of each other. To recapitalize the two aircraft would cost about $1B each per year, starting in the early-2030s.

FVL will also maintain the US industrial base when the Army’s procurements of the AH-64E and UH-60M end in the mid-2020s. Today’s UH-60M Black Hawk, AH-64E Apache and CH-47F Chinook are near their assault, attack and cargo helicopter plateaus. “That doesn’t mean they’re not going to be good downstream,” said Rugen. “They’re going to be okay. But if you want a revolutionary jump, you really have to go to the future and the advanced rotorcraft.”

Advanced rotorcraft promise the Army greater standoff ranges and new capabilities to overmatch advanced threats. Rugen summarized, “We want to operate from relative sanctuary, disaggregated, so not tied to a ship port or an airfield. That’s inherently vertical lift. We want to quickly aggregate. That speaks to the agility of our systems and the range of our systems,” which will attack and suppress the enemy air defenses.

“Then we start dis-integrating their A2AD [area access and area denial] layers and structures.” Rugen continued, “As we dis-integrate their A2AD, we then need the speed, range and endurance to exploit that breach in their layers of defense. We want to leverage deep interoperability across intel, fire and maneuver [elements], so it’s not just an aviation-centric event.”

Officially, FVL still stretches from Capability Set (CapSet) 1 manned and unmanned air systems (UAS) and light manned scouts to CapSet 5 heavy lifters. Bell and the Sikorsky-Boeing
team built their joint multi-role technology demonstrators (JMR-TDs) to model the CapSet 3; the Army’s CapSet 3 solution is the Future Long Range Assault Aircraft (FLRAA). However, plans for a Future Attack Reconnaissance Aircraft (FARA) now outpace and overlap development and production of the FLRAA squad carrier. Five industry players have contracts to design the CapSet 1 scout for competitive prototyping. Rugen said, “We have to have industry competing to keep the cost down, but also to get a better product downstream.”

There are two aspects of the Army’s Future UAS (FUAS) line of effort. Air Launched Effects (ALE) describes armed and unarmed vehicles small enough to launch from the optionally manned FARA and FLRAA. Under FUAS, a ground-launched, platoon-level Future Tactical Unmanned Aircraft System (FTUAS) will replace today’s Textron RQ-7 Shadow. Like the optionally manned FVL aircraft, the FUAS platforms will share a Modular Open System Architecture (MOSA) modeled in MSAD — the Mission System Architecture Demonstration.

All four FVL-related lines of effort — FARA, FLRAA, FUAS and MOSA — promise joint-service payoffs. US Special Operations Command (SOCOM) wants the FLRAA to succeed the latest MH-60M Black Hawk. The Marine Corps initially looked to the 30,000 lb (13.6 t)-class FLRAA to replace its new UH-1Y utility and AH-1Z attack helicopters. The Navy and Marine Corps now expect the 14,000-lb (6,350-kg) FARA to spin-off a CapSet 2 Attack Utility Replacement Aircraft (AURA) that fits small-deck ships. FARA requirements also include US Coast Guard and SOCOM appendices. Evolving Marine Corps UAS requirements may draw on ALE and FUAS technologies. Whatever the platform, MOSA aims to speed new capabilities to the fleet and end expensive “vendor lock” dictated by proprietary software and hardware.

**Multi-Service, Army-Led**

FVL consequently remains a joint-service initiative but now more clearly led by the Army under a recent Army decision memorandum. Rugen explained, “We really want the trust amongst the services to execute a Black Hawk-like program and not necessarily a joint program, a joint program office, and a lot of the problems that are entailed by that.” He added, “We still have Marine Corps participation within the program office, and then obviously SOCOM participation as well. This is not a sundering of a great partnership that has been going on for a number of years but really an evolution of it.”

Also evolved are FVL priorities. The CapSet 3 FLRAA originally led FVL plans, in part because a Black Hawk/ Apache/Seahawk/Venom/Viper replacement offered the biggest potential market to revitalize the US rotorcraft industrial base. Schedules originally called for a Black Hawk replacement in production around 2030 and an Apache replacement around 2032. However, real-world needs moved the smaller FARA to the top of capabilities required. Denied the OH-58F Cockpit and Sensor Upgrade Program (CASUP) and apparently disappointed by the scouting performance of manned Apaches with unmanned RQ-7B Shadows and General Atomics MQ-1C Gray Eagles, the Army formulated a competitive prototyping program for the CapSet 1 FARA. Two FARA contenders should begin flight testing in November 2022 to pick a winner in 2024 for fielding around 2028.

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**FLRAA Starts to Get Real**

The Army released a joint service-focused request for information (RFI) on April 4, and held an industry day in Huntsville, Alabama, on July 31. A draft request for proposals (RFP) was not released by press time but is expected this summer.

As covered in the May/June issue of Vertiflite (“Future Vertical Lift Takes Off,” pg. 14) the RFI provided an accelerated schedule.
- Contract award in fourth-quarter fiscal 2021
- Preliminary Design Review in second-quarter fiscal 2023
- Prototype first flight in third-quarter fiscal 2024
- Weapon system Critical Design Review in fourth-quarter fiscal 2024

The RFI outlined the need for the first unit equipped in the second quarter of fiscal 2030, about two years earlier than prior schedules.

The FLRAA “Competitive Demonstration and Risk Reduction Effort” industry day announcement released by the Army Future Vertical Lift Project Office on June 28 laid out the FLRAA Project Manager’s approach to conducting the CD&RR activities to inform the FLRAA requirements and acquisition strategy. Specifically, the service intends to utilize the Army’s Combat Capabilities Development Command (CCDC) Aviation and Missile Center (AvMC) Other Transaction Authority (OTA) with the industry Aviation and Missile Technology Consortium (AMTC) — comprised of the Vertical Lift Consortium (VLC) and the National Armaments Consortium (NAC).

The Army is giving the four JMR-TD teams extensions of their existing technology investment agreements (TIAs) with additional funding from this year’s $20M Congressional mark (at the request of VFS and VLC).

The Army plans select up to two companies to execute the FLRAA CD&RR effort in fiscal years 2020–2021.

The CD&RR plan is to have two phases. Phase I — with $75M–$130M distributed between the two teams — will focus on systems engineering activities to support the establishment of a system functional baseline to include execution of an Initial Design Requirements Review (IDRR) and Initial Design Functional Review (IDFR). The potential follow-on Phase II, with $90M total available, would lead to weapon system refinements and an Initial Design Concept Review (IDCR).

The Army plans to follow this by a downselect to a single vendor in fiscal 2021 for the FLRAA development program of record, estimated at $4.5B.

Meanwhile, the FLRAA analysis of alternatives (AoA) was submitted to the Pentagon’s Office of Cost Assessment and Program Evaluation (CAPE) in May (CAPE provided a sufficiency memorandum to Congress in late July) and an abbreviated FLRAA Capability Development Document (CDD) was approved by the Army Requirements Oversight Council in early-July.

For more about the FVL program, see [www.vtol.org/FVL](http://www.vtol.org/FVL).
Expedited decision cycles and contracting processes may align the two aircraft. “We’re looking at a multi-year acceleration in Capability Set 3,” said Rugen. The Army is committed to that. I think when we talk about the folks in our chain of command, the department, and obviously the legislative branch, I think they’ve been clamoring for the Army to move out on a multi-year acceleration.”

Whatever the accelerated schedule, FVL has to balance premium capability with manageable cost. The FLRAA to replace the Black Hawk is supposed to hover for 30 minutes over a mountain landing zone at 6,000 ft and 95°F (1,800 m and 35°C). “There’s a lot of things that fall out from high-hot hover capabilities mid-mission,” said Rugen. Large rotorcraft with excess power can, for example, carry more auxiliary fuel to extend range. However, “the debate should be, ‘Do you want high-hot?’ If you look at ... a European scenario, an Arabian scenario, a North Korean scenario, an Indo-Pacific scenario, could you come off of that?” Rugen concluded, “Being everything to everybody all the time [makes] a very costly aircraft and very sub-optimal [solution].”

Rugen later explained to Vertiflite that a Joint Trades analysis between the Army, Marines and SOCOM was conducted as part of the recently-completed Analysis of Alternatives (AoA) to best understand service-unique and service-common requirements. The analysis was instrumental in understanding the timing for delivering future capability, and the tradeable and non-tradeable requirements for each service.

Paying for concurrent FARA and FLRAA development and production apparently ends further Black Hawk and Apache block upgrades. Rugen said, “The current fleet is very well modernized, and we have taken those investments, those big buysouts, and redirected them into the future vertical lift.” Undecided are schedules for CH-47F Block II enhancements and a CapSet 5 heavy lifter to replace the Chinook. CH-47F modernization and the Army Aviation Restructure Initiative has already given the Army a young cargo fleet.

For the foreseeable future, the modernized Chinook will exploit maneuver windows in enemy defenses opened by FARA, FLRAA and joint forces. “If the future force generates freedom of action in the air domain — if we start dis-integrating their A2AD — that’s our critical path, at which time the Chinook can come forward” onto the battlefield.

FARA

In April, the Army announced competitive prototyping agreements with industry to design, build and test future attack reconnaissance aircraft able to avoid radar detection and operate in tight urban “canyons.” The optionally manned scout is expected to have an open avionics architecture and exercise some level of interoperability with unmanned systems. AVX Aircraft teamed with L3 Integrated Systems (now L3Harris Technologies) to bid a compound coaxial helicopter with highly integrated sensors and systems. Bell must forgo tiltrotor speed and range for a more compact urban footprint, but alludes to a FARA with fly-by-wire flight controls and other technologies from the big, commercial Bell 525 Relentless. Boeing has revealed nothing of its FARA concept but plans to leverage its AH-6i and AH-64 integration experience for the new armed scout. Karem Aircraft, now teamed with Northrop Grumman and Raytheon, plans a FARA configuration very different than the optimum speed tilt rotor (OSTR) proposed for the JMR-TD but expects to leverage many of the component technologies. Sikorsky’s 11,000-lb (5.5-t) S-97 Raider demonstrator has been showing off its X2 compound helicopter technologies applicable to the Army’s requirements for the slightly larger and slower FARA.

According to General Rugen, “We will down-select from those five to two in March 2020. At which time we will go to final design and start building competitive prototypes and we have a government-sponsored flight test and flight evaluation in fiscal year 2023, so the flying actually should start in November 2023.” The FARA is supposed to cruise at 180 kt (333 km/hr) or above and dash at over 200 kt (380 kph), slower than the big future long-range assault aircraft it will support, but agile enough to exploit low altitude airspace. City squares capped FARA main rotor diameter and overall width at 40 ft (12.2 m). With a 20mm cannon and integrated munitions launcher, the new armed scout will have a gross weight...
The Bell V-280 Valor demonstrator models a CapSet 3 Future Long Range Assault Aircraft to give the Army standoff range and overmatch capability impossible with today’s helicopters. (Bell photo)

The Bell V-280 Valor has topped 300 kt (555 km/h) true air speed. The third-generation tiltrotor has also exercised the low-speed agility necessary for the air assault mission.

The FVL team has also used the Vertical Motion Simulator at NASA Ames Research Center. “We did that with 23 pilots across all services and the Coast Guard, some of which were experimental test pilots, but some of which were just line pilots. We studied the agility of these advanced rotorcraft platforms.”

The Sikorsky-Boeing SB>1 Defiant has flown three hovering sorties. In advance of flight envelope expansion, program engineers are increasing the power on the Defiant Propulsion Systems Test Bed (PSTB). According to the Sikorsky-Boeing team, successful expansion of the PSTB endurance envelope will position the flying demonstrator for flight expansion envelope later this summer. Meanwhile, the smaller S-97 Raider continues to provide risk-reduction data for FLRAA, as well as a path to FARA.

Design houses AVX Aircraft and Karem Aircraft continue FLRAA work under their JMR technology investment agreements. AVX has previously tested a 1/10 scale model of a CapSet 3 coaxial compound helicopter in university wind tunnels and is now focused on the FVL CapSet 1 FARAScout.

Karem Aircraft is assembling and integrating a single-rotor tie-down (SRT) test rig to demonstrate its OSTR technology. The company reports that the blades, individual blade actuators and hub are complete, and the nacelle structure and drivetrain are in final assembly for integrated rotor system tests to begin in September. Karem is also working with the Army under the JMR-TD program to model survivability features of the OSTR. The company has developed signature and performance models used Army’s wargaming simulations to assess OSTR survivability.

Still missing from FVL plans is a fuel-efficient 5,000-shp (3,700-kW) turboshaft for a production FLRAA to reach its desired range. The Bell V-280 ferried itself 370 nm (685 km) from the Bell assembly facility in Amarillo, Texas, to the company’s flight test center outside Fort Worth with twin General Electric T64-GE-419 turboshafts. The same 4,750-shp (3,540-kW) engines are today in the Marine Corps CH-53E. The Sikorsky-Boeing JMR demonstrator has two Honeywell T55-GA-714A turboshafts like those found in the CH-47F Chinook, each rated 4,777 shp (3,562 kW) at takeoff.

ADD engineers also witnessed preliminary tests of air-launched effects in Israel. “We shot four Spike NLOS [non-line-of-sight missiles] off D-model Apaches,” cited Rugen. “We will take that Spike NLOS out to Yuma this summer, and ADD folks will fire it off a US Apache Guardian... When we talk about standoff and overmatch, we need more than 8-km [5-mile range] that the current Hellfire provides. For our pacing threat, we still need Hellfire and JAGM [Joint Air-to-Ground Missile] for any kind of armored tank killing. But when you talk about integrated defense, we need something that reaches out a little farther.”
Central to FVL is a modular open system architecture (MOSA) to tailor air vehicle capabilities quickly and affordably. MOSA standardized software tools and non-proprietary interfaces should integrate new functions into aircraft to counter changing threats. The three-phase Mission System Architecture Demonstration (MSAD) runs through December 2020. Two mission systems architecture capstone demonstrations using government-defined standards and interfaces have been well-received by industry, according to Gen. Rugen. “We've seen, in a test environment, integration of capability into an aircraft-like SIL [systems integration laboratory] happen at timelines that are compelling.”

FVL mission systems work goes beyond the cyber-secure MOSA. According to Gen. Rugen, “We want to understand model target recognition better. Primarily, too, we want to understand how commanders make decisions and do auto exploitation and dissemination of appropriate intelligence. What we're seeing now is just the vast amount of data that is given to a commander, reported to a commander, or afforded to a pilot in the front seat of an Apache. We want the algorithm to sift that data and give us the relevant data.”

The Martin V-Bat is one possible Future Tactical UAS to replace today's RQ-7 Shadow. (Martin UAV photo)