THE FUTURE OF **ARMY ASSAULT**

As the US Army prepares for the mass recapitalization of its aviation assets, *Combat Aircraft Journal* examines the FLRAA program, which will provide the service's next-generation medium-lift helicopter.

REPORT **Khalem Chapman**

FOR MORE THAN 40 years, Sikorsky's UH-60 Black Hawk medium-lift utility helicopter has been the backbone of US Army air operations. More than 1,500 examples have been delivered to the service across multiple variants throughout its operational career, which started with the 101st Combat Aviation Brigade in June 1979.

As the venerable Black Hawk entered its fourth decade of operations, the army was hosting a Joint Multi-Role Technology Demonstrator (JMR-TD) project, which sought to develop, demonstrate and mature technologies before launching its Future Long-Range Assault Aircraft (FLRAA) campaign that will ultimately decide on the UH-60's successor. Falling under the US Army Futures Command's wider Future Vertical Lift (FVL) portfolio, FLRAA looks to provide a platform with more enhanced characteristics than the Black Hawk, including increased range, speed, mobility and payload capacity, along with greater survivability, reliability and sustainability.

Concept artwork of Bell's V-280 Valor in its assault configuration. Note the fuselage-mounted AGM-114 Hellfire missiles and what appears to be side-facing, tube-launched weapon systems. **Bell**

In a request for information (RFI) issued in April 2019, the US Army detailed its need for a 'solution that is operationally effective, suitable and survivable in a 2030 threat environment'. It seeks to procure a platform that has the potential to increase its capabilities — using a modular open-systems approach — and maintain its relevance over a 50-year useful lifespan. It must also be in line with affordability objectives; having an average unit manufacturing cost capped at $43

Sikorsky has partnered with Boeing on the SB-1 Defiant, seen here in a possible production configuration. **Sikorsky**

million. The plan is to field the FLRAA by early 2030 — two years after it aims to accept the first examples of the winner of its sister project, the Future Attack Reconnaissance Aircraft (FARA).

The FLRAA will be tasked with air, amphibious and urban assault, along with executing a variety of missions, including security, attack, maritime interdiction, medical evacuation (MEDEVAC), humanitarian assistance/disaster relief (HA/DR), tactical resupplying, non-combatant evacuation operations (NEO) and combat search and rescue (CSAR). A US Army spokesperson told *Combat Aircraft Journal*: 'FLRAA is required to have two medium caliber machine guns [and] Air Launched Effects (ALE) may be integrated in the future.' The spokesperson added that it would have 'enhanced pilotage, increased autonomy and improved survivability', along with being interoperable with the army's unmanned platforms. The platform will be configured to carry 11 air assault troops (an army infantry squad), along with supplies and weapons systems such as light artillery pieces.

FLRAA CROSS-SERVICE MINIMAL REQUIREMENTS

	US Army/SOCOM	USMC
Unrefueled combat radius	200nm (230 miles/370km) with 30 minutes of loitering time	365nm (420 miles/ 675km) with 30 minutes of loitering time
Maximum gross weight/full payload continuous cruise speed	250kts (287mph or 463km/h)	305kts (350mph or 564km/h)
External payload	Between 8,000lb (3,638.7kg) and 10,000lb (4,535.9kg) with cargo hook capacity	N/A
Internal payload	5,000lb (2,267.9kg)	4,400lb (1,995kg) maximum
Crew	4	4
Passenger capacity	10-12	8
Condition-based maintenance	Capable of conducting 100 flight hours over a 45-day period between scheduled maintenance during operations	N/A
In-flight refueling capability	Shall include structural engineering to facilitate installation of an air-to-air refueling system	Aircraft must include the capability for air-to-air refueling

Involvement across the services

FLRAA has attracted attention from the US Marine Corps (USMC) and Special Operations Command (SOCOM). The marines are seeking to procure 349 examples to replace the Bell UH-1Y Venom twin-engine, medium-lift utility helicopter, which began operations in 2007. Currently, the service operates 141

Venoms from a total of 165, with 12 in storage, seven lost to attrition and five having been withdrawn from use. The RFI adds that the USMC is seeking to begin its acquisition program two years after the US Army.

The USMC is also seeking to procure an attack variant of the FLRAA. This version would be capable of employing both internal and external weapons, including a fixed or turreted gun system, guided/unguided rockets, air-to-air and air-to-ground missiles — such as the AGM-114 Hellfire and AGM-179 Joint Air-to-Ground Missile (JAGM) – along with the ability to deploy unmanned aerial vehicles (UAVs).

SOCOM's requirements are broadly the same as the army's, but it adds that the craft must be configurable for transport aboard a single C-17A Globemaster III.

The contenders

The JMR-TD project started out with four contending companies, but in August 2014, designs from AVX Aircraft and Karem Aircraft were dropped — leaving just the Bell V-280 Valor and the Sikorsky/Boeing SB-1 Defiant, which went on to be developed into flying prototypes and are currently in flight-test.

The differences between the two are exponential, mainly because both teams are offering a different type of aircraft. The Valor is a compound tiltrotor, whereas the Defiant follows a state-of-the-art digital design and employs technology used in

Below: The V-280 is a third-generation tiltrotor, which follows a remarkably different design compared with other aircraft in its class, such as the Osprey. It uses a V-tail, smaller wings and a sleeker, compound fuselage. It is also smaller than the V-22. **Bell**

Left: The Defiant follows a compound, blended fuselage design, with a lift offset coaxial main rotor and rear-mounted pusher propeller to enhance maneuverability and generate higher flight speeds. **Sikorsky**

Right: The SB-1 Defiant is the largest platform produced by Sikorsky, designed to employ its X2 high-speed technologies. **Sikorsky**

Sikorsky's X2 experimental high-speed helicopter, incorporating a counter-rotating coaxial rotor and pusher propeller. The similarities between the two are that both platforms use a fly-by-wire flight control system, have larger cabin spaces when compared with the Black Hawk, have a retractable undercarriage, a built-in aerial refueling capability, and each aircraft essentially takes the traditional helicopter design and tears it up!

Bell's V-280 prototype — registration N280BH (c/n 60105) — first flew on December 18, 2017, at the company's facility in Amarillo, Texas. Bell boasts that the V-280 will have a combat range of between 500nm (575 miles/926km) to 800nm (920 miles/1,481km), a cruising speed of 280kts (322mph or 518km/h) and a high-hot hover out of ground effect (HOGE) of 6,000ft (1,800m) at 95°F (35°C). The aircraft has the flexibility to provide responsive logistical support in defensive/offensive operations and can be configured for both internal and external payloads.

To reduce complexity, Bell says it will employ a 'revolutionary approach to manufacturing and reducibility for [the Valor's] blade, wing and cabin assemblies'. It adds that it is 'building on 450,000 hours of tiltrotor experience' to reduce sustainment costs using focused systems and component redesign. This experience comes via the V-22 Osprey, the first tiltrotor to enter operational military service — a joint venture between Bell and Boeing — which started development in the early 1980s.

Sikorsky has partnered with Boeing on designing, testing and demonstrating the SB-1. The design shares similarities with the company's FARA offering — the Raider X — by using X2 technology to provide 'unmatched capability growth potential'. The Defiant follows a compound, blended fuselage design, with a lift offset coaxial main rotor and rear-mounted pusher propeller to enhance maneuverability and generate higher flight speeds. It also features an advanced rigid rotor system with manually foldable rotor blades, cabin space for up to 12 combat-equipped troops and active rudders, elevators and vibration controls. It will also be able to team up with autonomous platforms, providing the US Army with capabilities not currently available to the service.

The aircraft will employ new technologies and systems to provide self-monitoring and condition-based maintenance to increase the platform's operational availability, enabling far greater in-service flexibility. It will be part of an already established supply chain to reduce overall life-cycle costs while

Above left to right: The V-280 in fast forward flight during testing. **Bell**

A fine shot of the V-280 with rotors tilted upwards for slow forward flight. **Bell**

FLIGHT-TESTING

According to Dan Bailey of the Joint Multi-Role Future Vertical Lift (JMR FVL) project at the US Army's Aviation and Missile Research, Development and Engineering Center (AMRDEC): 'The intent of the JMR-TD effort is to maximize the knowledge gain and risk reduction toward an anticipated [FVL] acquisition.'

Since the Valor's first flight it has undergone a rigorous test campaign with company and US Army test pilots, amassing more than 150 flight hours. The V-280 has achieved multiple milestones, from reaching true airspeeds of 300kts (345mph or 555km/h) to assessing fast rope deployment options and low-speed agility.

On December 18, 2019 — two years after its first flight — the Valor flew autonomously for the first time in a demonstration in front of army representatives and members of the press. The display consisted of two sorties, with the aircraft performing an unmanned take-off and landing. It also autonomously converted between cruise and vertical take-off and landing modes, performed loiter maneuvers and precisely navigated through various waypoints.

The Valor has flown test flights using Lockheed Martin's Pilotage Distributed Aperture System (PDAS) mission equipment package, which provides a 360° situational awareness sphere around the aircraft, supplying real-time, multi-spectral fused imagery to the pilots and crew through head-tracked, high-resolution helmet-mounted displays. The system employs a network of sensors distributed around the aircraft and follows a modular open systems architecture (MOSA) approach to allow the rapid integration of new technologies.

The Defiant is undergoing a flight-test campaign at Sikorsky's Development Flight Test Center in West Palm Beach, Florida. During this it has performed maneuvers at 30° angles of bank and has flown with its landing gear retracted. The SB-1 prototype continues to expand its flight envelope, having reached speeds of 140kts (161mph or 259km/h) in February. The Sikorsky/Boeing team states that the Defiant is working its way up to the army's speed requirement and believes that the aircraft will be able to reach top speeds of 250kts (287mph or 463mph). In mid-February, the SB-1 performed a demonstration in front of army and congressional representatives.

Above left to right: An airborne shot of the V-280 – which has reached true airspeeds of 300kts (345mph or 555km/h).**Bell**

The Valor has flown autonomously, flying two sorties, with the aircraft performing unmanned take-offs and landings. **Bell**

Below: The SB-1 prototype is put through its paces at Sikorsky's Development Flight Test Center in West Palm Beach. **Sikorsky**

increasing efficiency and decreasing the time taken for new systems, such as sensors and munitions, to be integrated onto operational examples using a modular open systems architecture (MOSA)-based approach.

The first SB-1 prototype — N100FV (c/n 100-0001) — flew on March 21, 2019, just over a year after the V-280. Its inaugural flight was delayed due to issues with blade production, specifically in setting up the automated fiber placement tooling to manufacture its composite rotor blades. Then a fault was discovered with the gearbox in the propulsion system test bed (PSTB), which validates the capability of all the Defiant's major systems, including the dynamic drive and rotors.

What next for FLRAA?

Both teams are continuing their respective test campaigns, further developing the technology, maturing the platforms, expanding their flight envelopes and mitigating technical risks.

Although the V-280 is further along — having not been hit with the issues and delays that the SB-1 experienced — a US Army spokesperson assured *Combat Aircraft Journal* that this would

not influence the service's decision as both platforms were developed under JMR-TD and not as combat-capable products directly produced for FLRAA. The spokesperson added: 'Both JMR-TD vendors [have] completed significant technology maturation and demonstration… These efforts provide valuable insights into the technical risks that may be experienced during the [FLRAA program].' The service is getting ready to bring the JMR-TD project to a close as it moves to officially launch its FLRAA campaign.

As per the army's schedule, it has awarded Bell and a Sikorsky-Boeing teams Competitive Demonstration and Risk-Reduction (CD&RR) contracts. The service announced the contracts on March 16, but the value was not disclosed. The risk-reduction effort will allow the two parties to refine their designs in advance of a fly-off competition in 2022. The service will then select a winner, with aims to begin phasing out its older UH-60s and replacing them with the FLRAA platform at the turn of the decade.

Above: The V-280 Valor has already assessed fast rope deployment and low-speed agility. **Bell**

Below: The SB-1 prototype reached speeds of 140kts (161mph or 259km/h) in February. **Sikorsky**

Although the FLRAA campaign is gathering pace, the Black Hawk is still being further upgraded and developed, with the army planning to convert 760 UH-60Ls to UH-60V standard in a process which started in Fiscal Year 2019.

With more than 1,500 Black Hawks in service and UH-60V conversion taking place on more than half of them over the next decade, the service may elect to place a low initial order of FLRAA platforms as the enhanced Black Hawks could complement the V-280 or SB-1 throughout its early years of service.

> "FLRAA is required to have two medium caliber machine guns [and] Air Launched Effects (ALE) may be integrated in the future
>
> **US Army spokesperson**

Combat Aircraft Journal evaluates the US Army Future Attack Reconnaissance Aircraft program.

REPORT **Tom Kaminski**

THE US ARMY has announced that designs offered by Sikorsky Aircraft and Bell Helicopter Textron have been selected to move forward in the next phase of its Future Attack Reconnaissance Aircraft Competitive Prototype (FARA CP) program. The army announced the decision on March 25, 2020, with the award of Other Transaction Authority Prototype (OTAP) agreements that provided Bell with more than $700 million, while Sikorsky received $940 million. The FARA CP solicitation is structured into three phases, comprising preliminary design; detailed design, build, and test; and prototype completion assessment and evaluation for entrance into production phase. The FARA CP is managed by the US Futures Command and the US Army Combat Capabilities Development Command Aviation and Missile Center's Aviation Development Directorate.

The FARA path

Under Phase 1, five OTAP agreements for the aircraft design, build, and test of FARA were awarded on April 23, 2019. The five contractors and industry teams comprised AVX Aircraft Company and partner L3Harris Technologies, Bell Helicopter Textron, the Boeing Company, Karem Aircraft, and Lockheed Martin's Sikorsky Aircraft subsidiary. The five participants developed competitive prototype designs in accordance with the US Army requirements.

Following an initial design and risk review assessment that was conducted with each team, the designs were appraised to determine how well they met capability requirements, their maturity and how each company/team was 'postured' to meet the army's development and competitive prototyping schedule. Sikorsky and Bell were selected to proceed to the next phase.

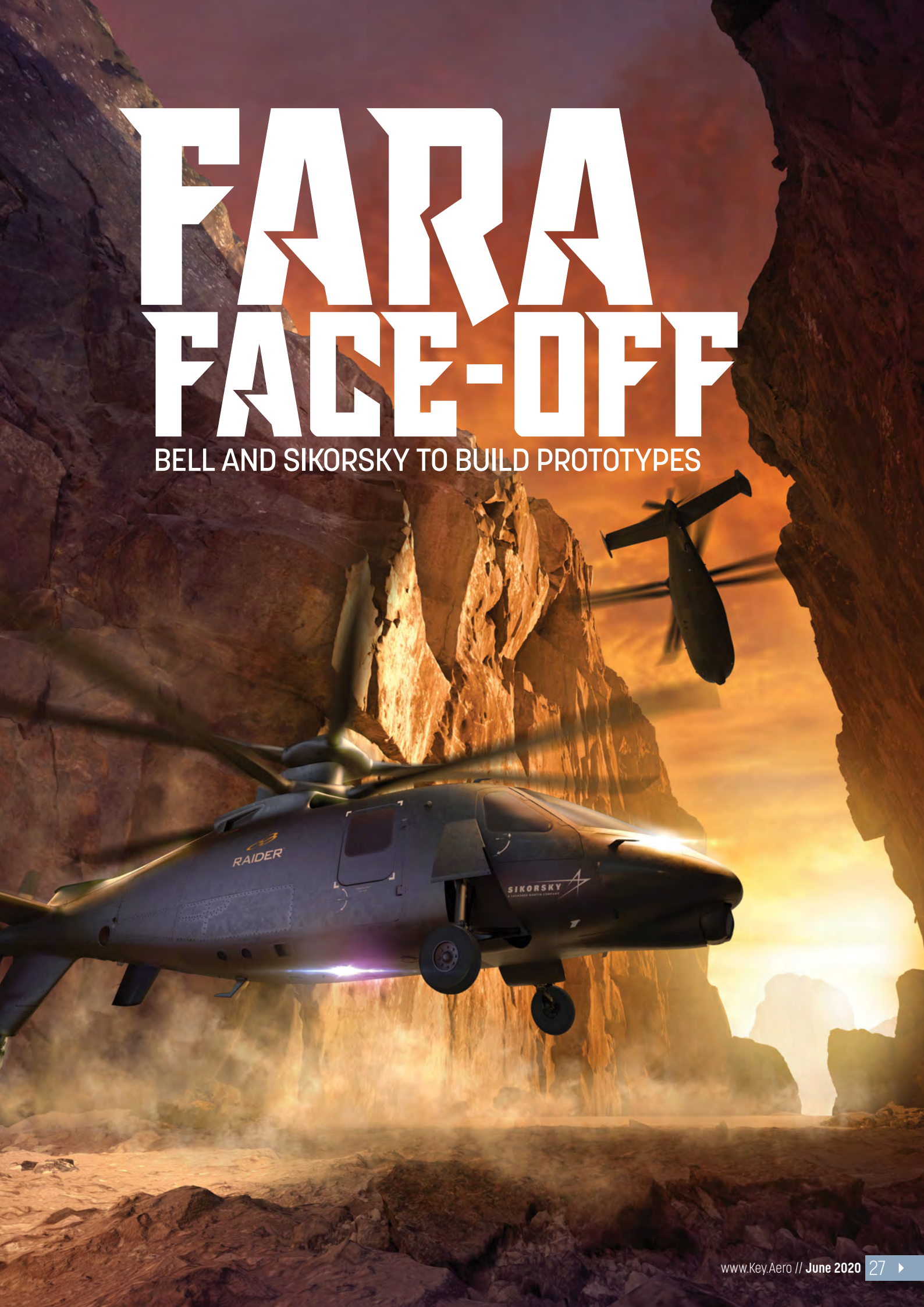
Under Phase 2, the contractors will complete detailed design, build, and test of their respective prototypes. Phase 2 will conclude with a US Army flight-test evaluation/competitive fly-off in late-2023. The winning design's engineering and manufacturing development (EMD) phase will begin in Fiscal Year 2024 and fielding will commence in 2030.

Above: : An artist's rendition that was released with the Bell 360 Invictus unveiling. **Bell Helicopter**

Right: A Raider X artist impression that acknowledges the fact that the type is intended to be able to operate in tight locations. **Lockheed Martin/ Sikorsky**

FARA FACE-OFF

BELL AND SIKORSKY TO BUILD PROTOTYPES



Raider X uses a coaxial, rigid main rotor configuration with an aft-mounted pusher propulsor. **Lockheed Martin/Sikorsky**

Released in October 2018, the FARA CP solicitation's mandatory requirements included integration of government-furnished equipment that comprised the engine, 20mm cannon, integrated munitions launchers (IMLs) and the Modular Open Systems Architecture (MOSA). Referred to as a 'digital backbone', the MOSA will provide an interface between weapons and Air-Launched Effects (ALE) mini-drones carried on the IML and the aircraft. The interface will preclude the need to modify the aircraft each time a new weapon is introduced. The service's requirements included a minimum cruise speed of 180kts (333km/h), a target gross weight of 14,000lb (6,350kg), a maximum 40ft diameter (12.2m) rotor, and an affordability goal. Range, endurance, and payload were among the desired requirements that were provided to the industry as guidelines for specific designs.

What is FARA designed to do?

The US Army wants the FARA to operate in 'complex airspace and degraded environments against peer and near-peer adversaries with an advanced integrated air defense system'. It will deliver the capability to conduct armed reconnaissance, light attack, and security with improved stand-off and lethal and non-lethal capabilities. Its size will allow it to 'hide in radar clutter' and operate in 'the urban canyons of mega cities'.

According to the US Assistant Secretary of the Army for Acquisition, Logistics and Technology, Dr Bruce D. Jette: 'The Future Attack Reconnaissance Aircraft is the army's number one aviation modernization priority and is integral to effectively penetrate and dis-integrate adversaries' Integrated Air Defense Systems.' Describing FARA, Dr Jette also said: 'It will enable combatant

Below: The S-97 Raider high-speed FARA demonstrator first flew in May 2015 and its technology forms the basis of the Raider X. **Lockheed Martin**

ARMED SCOUT – A TROUBLED TALE

The army has tried and failed three times to develop a replacement for the OH-58D Kiowa Warrior. The RAH-66 Comanche program and the subsequent ARH-70 Armed Reconnaissance Helicopter (ARH) and Armed Aerial Scout (AAS) programs were canceled in February 2004, October 2008, and late-2013, respectively. A plan to upgrade the OH-58D to the more capable OH-58F configuration was also abandoned when the decision was made to divest the service's fleet of 368 Kiowa Warriors due to budget cuts in January 2014. Since retiring the OH-58Ds, the army has used AH-64D/E attack helicopters paired with unmanned RQ-7Bs to carry out the armed reconnaissance/scout mission. The FARA may ultimately replace up to half of the service's AH-64D/E attack helicopter fleet.

> Its size will allow it to 'hide in radar clutter' and operate in 'the urban canyons of mega cities'

commanders with greater tactical, operational and strategic capabilities through significantly increased speed, range, endurance, survivability and lethality.'

The army is developing FARA as part of its Future Vertical Lift (FVL) program, which also includes the Future Long-Range Assault Aircraft (FLRAA) that will replace the UH-60 medium-lift utility helicopter, Future Unmanned Aircraft System (FUAS), and Advanced Unmanned Aircraft Systems (AUAS).

The army selected Bell and the Sikorsky-Boeing team to build prototypes for the FLRAA on March 16. The two received $84 million and $97 million to continue development of their respective V-280 Valor tiltrotor and SB-1 Defiant high-speed helicopter designs. The prototypes were originally produced under the army's Joint Multi-Role Technology Demonstration (JMR-TD).

FVL began as an army-led multi-service initiative, focused on enhancing vertical lift dominance by developing next generation capabilities. The program was intended to herald rotorcraft with greater speed, reach, protection, lethality, agility, mission flexibility and survivability. Each FVL category aircraft will be optionally manned with modular open system architectures and vertical take-off and landing features. FARA was originally referred to as FVL Capability Set One.

Initiated with a $1.9 billion OTAP solicitation, the FARA, which has been referred to as the 'knife-fighter' of future US Army Aviation, will fill a capability gap, created by the divestiture of the OH-58D scout helicopter — the last Kiowa Warrior was retired in September 2017.

Winning designs

The Bell and Sikorsky initial designs met the army's mandatory requirements and were in acceptable risk levels when viewed against the desired requirements in the army's funding profile.

Known as the 360 Invictus, Bell's design is a high-speed helicopter that features a single main rotor and lift-sharing wing. Its transitional helicopter design was intended to keep it affordable and emphasized simplifying processes to

Above: The Raider X features side-by-side seating, which Sikorsky claims improves crew co-ordination and situational awareness. **Lockheed Martin/ Sikorsky**

Right: The Bell 360's armament will be carried internally on an integrated munitions launcher and the aircraft will have a 1,400lb (635kg) payload. **Bell Helicopter**

provide warfighters with a sustainable and maintainable aircraft. The helicopter's fully articulated four-blade main rotor system and fly-by-wire flight control system will be developed from the 525 Relentless commercial helicopter, which has demonstrated speeds in excess of 200kts during test flights. The main rotor diameter will be less than the army's 40ft (12.19m) maximum.

The design features lift-sharing wings that reduce rotor lift demand in forward flight and enables high-speed maneuverability. Additionally, it includes a canted, ducted tail rotor, and an integrated supplemental power unit (SPU). The 586shp (439kW) Pratt & Whitney Canada PW-207D1turboshaft engine will provide auxiliary power for ground operations and contribute additional horsepower in flight to boost cruise speed, dash speed and hover capability.

The 360 Invictus will have a top speed greater than 185kts (343km/h), a combat radius of 135nm (250km) with more than 90 minutes of time on station and will be capable of hovering out of ground effect (HOGE) at 4,000ft (1,219m) in 95°F (35°C) temperatures. The helicopter's low-drag, two-seat tandem cockpit will also feature a modular architecture and its systems will include avionics hardware and software developed with Collins Aerospace. Armament will be carried internally on an integrated munitions launcher and the aircraft will have a 1,400lb (635kg) payload.

Unveiled at the Association of the US Army's (AUSA) annual conference in October 2019, Sikorsky's Raider X is based on its S-97 Raider technology demonstrator. The compound helicopter design retains the basic X2 Technology coaxial, rigid main rotor configuration with an aft-mounted pusher propulsor, but will be 20 per cent larger than the S-97. Whereas the S-97 has 34ft (10.4m) diameter coaxial main rotors, the Raider X will feature two 39ft (11.9m) diameter four-blade rotors and fly-by-wire flight controls. The Raider X design has a 14,000lb (6,350kg) gross weight compared with the S-97's 11,000lb (4,990kg).

The S-97, which first flew in 2015, has already demonstrated speeds in excess of 200kts (370km/h). At high speed, 90 per cent of the engine power is directed to the pusher propulsor, which is declutched at low speed to reduce noise. Although Sikorsky has not released a top speed, it believes the Raider X will exceed the FARA's 180kt threshold maximum speed and could achieve speeds greater than 220kts (370km/h).

Closely resembling the S-97, the Raider X features side-by-side seating, which Sikorsky claims improves crew co-ordination and situational awareness. A large weapons bay that enables missiles and unmanned aircraft to be carried internally is located aft of the cockpit. According to Sikorsky, the large bay also provides growth space for future, larger systems. By retaining the basic design of S-97, Sikorsky plans to deliver an integrated weapon system that combines speed, range, maneuverability, survivability and operational flexibility. Swift Engineering will design and build the Raider X fuselage as a key partner with Sikorsky.

Sikorsky reports that these technologies will permit the Raider X to operate at high speeds while maintaining the low-speed handling qualities and maneuverability displayed by conventional single main rotor helicopters. It is designed for hot-and-high operations, and will be capable of flying at 10,000ft (3,048m) in 95°F (35°C) temperatures.

Both FARA prototypes will be powered by the GE Aviation T901-GE-900 turboshaft engine, which was developed under the army's Improved Turbine Engine

The Raider will feature Sikorsky's Collier-award winning X2 Technology that enables it to reach speeds of more than 220kts. **Lockheed Martin**

INNOVATIVE DESIGNS

The three designs that were not selected nonetheless included several innovative features that, as the US Army reported: 'advanced the science of vertical lift'.

The AVX and L3Harris Technologies team was the earliest to unveil its FARA design, in April 2019. Referred to as a Compound Coaxial Helicopter, the winged design featured side-by-side seating, four-blade compound coaxial flexible main rotors and ducted fans at the tail that provided both forward and reverse thrust. During high-speed flight, the wings would provide up to 50 per cent of the rotorcraft's lift. A compact 'flat pack' transmission design permitted an open cabin concept. Whereas AVX was leading aircraft design, L3Harris focused on the rotorcraft's systems architecture, weapons and sensor integration and production processes. According to the team, its design met 100 per cent of the army's mandatory requirements and 70 per cent of its desired attributes.

Unveiled in October 2019, Karem Aircraft's AR-40 design was a winged, high-speed compound helicopter that featured an actively controlled, variable-speed, 40ft diameter main rotor, tilting compound wings, and a rotating tail rotor. The main rotor featured a rigid, hingeless hub with three stiff, lightweight blades. At high speed, the wing was designed to take the load from the main rotor and tilt to the vertical position in a hover. The uniquely designed swiveling tail rotor was intended to provide anti-torque control at low speeds, and propulsion for higher forward speed. The AR40 would reportedly exceed the army's threshold speed requirement by about 20 per cent, meaning it would likely reach 215kts (398km/h). It featured side-by-side seating with additional space provided behind the cockpit for future growth, mission equipment, or a cabin for personnel. Karem's teaming arrangement included Northrop Grumman and its Scaled Composites subsidiary for airframe production and support. Its Mission Systems division was on-board to provide the avionics and cockpit integration, with Raytheon performing mission-system integration.

Boeing was the last to unveil its FARA design concept, which was finally revealed just 22 days before the army's announcement, on March 3. The company's clean-sheet design featured a hingeless, six-blade, 'high-solidity' main rotor; a conventional four-blade tail rotor and a clutched four-blade propulsor propeller on the tail that respectively provided maneuverability at low speeds and high-speed capability. The design also featured a tandem-seat cockpit with modular, and reconfigurable, large-area displays. Doors covering internal weapons bays located on either side of the lower fuselage were equipped with integral weapons pylons. The design bore a striking resemblance to the Lockheed AH-56 Cheyenne attack helicopter, which first flew in 1967, and was equipped with a rigid main rotor and propulsor propeller. According to Boeing, rather than inventing new technologies, its design improved upon and integrated mature technologies in order to meet the army requirement within schedule and cost. The company's FARA bid was led by its secretive Phantom Works, and included its AvioniX and Aurora Flight Sciences divisions.

Above: Boeing was the last to reveal its FARA concept, but it didn't have to wait long before its proposal was rejected. **Boeing**

The FARA concept from AVX Aircraft and L-3 Communications was based on heavily modifying the OH-58 Kiowa. **AVX Aircraft**

Program (ITEP). The 3,000shp (2,200kW) class turboshaft engine will also likely be installed in UH-60 and AH-64 utility and attack helicopters as well as the planned FLRAA.

Construction and testing

The US Army plans to conduct Final Design Reviews of both FARA contenders in December 2020, prior to authorizing the start of construction. Approximately 24 months are allocated for construction and subsystem testing with flight-testing scheduled to begin in late-2022. The prototypes will move to the Redstone Arsenal in Alabama in summer 2023, where service testing will be conducted. The army intends to transition FARA into a formal Program of Record (POR) in Fiscal Year 2024. Production will get under way in 2028 and will reach its peak rate in 2032 when 30 aircraft are produced. The service plans to spend $15-20 billion to purchase as many as 300-400 FARA aircraft at an average cost of under $30 million each.

Although Increment 1 of FARA is intended to fulfill the scout/attack mission, subsequent increments will support other missions including special operations. Ultimately, the design could be modified to incorporate a passenger cabin allowing it to replace US Army Special Operations Command's (USASOC) AH/MH-6M Little Bird light attack/light assault helicopters.

The army received nearly $400 million for FARA in Fiscal Year 2020 and has requested an additional $514 million in 2021 to complete the final design phase. It plans to invest $2.13 billion in the program through 2024.

Above: Karem Aircraft's AR-40 design was a winged, high-speed compound helicopter that featured an actively controlled, variable-speed, 40ft diameter main rotor, tilting compound wings, and a rotating tail rotor. **Karem Aircraft**