FLYING SAFELY THROUGH THE OBSCURATION.

BY Tom Marlowe, SOTECH Correspondent

Air power is sometimes limited by environmental conditions—sometimes it is just too dark or foggy or dusty to take off or land a plane or helicopter. Consider the particularly challenging scenario of a sandstorm in the Middle East. Pilots simply cannot see where to land when the landing zone is completely obscured.

The U.S. military would like to be able to mitigate the impact that such brownout conditions have on its ability to bring aircraft home after a mission. In this goal, it perhaps has no stronger ally than Middle Eastern companies that have dealt with the problem for much longer than the United States. Israel-based Elbit Systems Ltd., which owns and operates a large U.S. subsidiary out of Fort Worth, Texas, has combined several off-the-shelf technologies to produce Dust-Off, a package that tackles just this problem.

“Once you have kicked up some dust, which happens anywhere from 20 to 40 feet above ground level, you are now disoriented, and you lose your situational awareness. Your environment is full of dust clouds and you can’t see the horizon or anything. If the pilot sets the helicopter down while the helicopter is laterally drifting, that is when problems occur. That is when the helicopter could tip over, and that is when troops in the back could be killed,” Benjamin Weiser, senior director of the Elbit Systems helicopter line of business, told *Special Operations Technology*
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So aircrews must deal with two parts of this problem—one that occurs before the aircraft enters the dust and the other after entering the dust. Dust-Off uses three systems integrated to guide pilots through brownouts, whiteouts, sea sprays and other environmental conditions that block the view of the landing zone, which must be clear for a pilot to land safely.

The three components that make up Dust-Off are a laser-radar system called Sword, a digital map system, and a helmet display and tracking system. Elbit Systems initially developed the Sword to detect wires and obstacles during level flight. It can detect 3-millimeter wires at two kilometers. Using Sword, the aircraft pilot can see readouts in both a helmet display and a heads-down display as the helmet includes a tracking system.

"The pilot sees a cue in his helmet with a symbol that directs his attention to the location of the landing zone, which also appears on the digital moving map," Weiser said.

The Sword, operating in a low-visibility landing mode, scans the ground in a highdensity pattern to detect even the smallest of objects in the landing zone. The system detects anything larger than 40 centimeters on one side, Weiser noted. The Sword pings the ground with its lasers and creates a digital terrain map, which updates the digital moving map in Dust-Off.

The digital map is based on a database, which is updated in real time with the digital terrain map via the Sword.

"So you are coming in and you are quite confident that the landing zone is clear for you. Now as the dust comes up, we have developed some unique intuitive symbology that allows you to detect drift," Weiser commented. "The problem once you are in the dust is to have the situational awareness and make sure you know exactly what the helicopter is doing relative to the terrain."

Most brownout solutions use 2-D displays or 2-D implementations of symbology, he added, but Dust-Off makes use of a 3-D representation of the terrain to make landing more intuitive for pilots. Most other systems use two symbols—one as a velocity vector and another as an acceleration cue. Pilots must receive training on what these symbols mean, and they have to translate their meaning in their heads to make movements that counter any drift incurred.

Dust-Off brings its 3-D representation of the terrain to its helmet-mounted display so the pilot can see his exact location relative to the terrain and safely land the helicopter.

"In helmet-mounted displays, we are by far the world leaders," Weiser commented. "We have fielded thousands and thousands of HMDs on fixed wing and on helicopters all over the world. We have millions of flight hours with these systems. We have digital maps on thousands of helicopters. All of the Israeli Air Force helicopters are outfitted with our digital map. The V-22 has our digital map as does the C-130. We have a lot of customers flying with our digital map."

Elbit Systems has tested Dust-Off in simulators and will flight-test it early next year.

ADVANCING NIGHT VISION

The U.S. military has made particular investments in equipment that boosts the situational awareness of helicopter crews. In 2005, the U.S. Army contracted Lockheed Martin to upgrade the target acquisition and designation sight (TADS) and the pilot night vision systems (PNVS) on its Apache AH-64 helicopters. To date, the company has delivered more than 500 chipsets to upgrade the systems on the helicopters, Monty Watson, Apache fire controls advanced programs manager at Lockheed Martin, told *SOTECH*.

"The mission in the Apache is to have the pilot get in and around an engagement area and then use TADS to prosecute targets," Watson described. "A good 80 percent of the mission is

supported by the PNVS with the remainder supported in the engagement area with the TADS. The sensor is designed for piloting with a headsteered FLIR providing high-resolution imagery for the pilot so he can safety ingress, egress and conduct pilot operations safely."

The TADS/PNVS systems in tandem worked so well for the Apache that Watson began to wonder why they weren't adapted for other platforms. So he started to examine the problem at Lockheed Martin, taking a look at the merging needs of his customers. Militaries were complaining of brownouts and object detection and avoidance—challenges that a PNVS system could tackle. So the company developed Pathfinder, based on the Apache PNVS without any redesign of the electronics or FLIR components.

Now Watson hopes to market Pathfinder to Army rotor wing aircraft as well as international cargo and utility helicopters. The sensor may also have fixed wing applications in the future.

Pathfinder is unique partly because it offers a high-resolution image to pilots in a helmet-mounted display. Other FLIRs are active in mid-wave ranges and act as steering arrays. They provide a resolution of 640 by 480, or about 0.3 megapixels. They are generally integrated into heads-down displays that require the pilot to look down to see them.

"It requires one of the two pilots in these cargo and utilities to engage with the FLIR and to look around and use the system, which draws attention from one of his primary functions to maintain heads-up and eyes-out to support the piloting of the aircraft," Watson observed.

Pathfinder, in contrast, offers 1,728 by 960 resolution, or 1.7 megapixels, for a high-definition display. Its long-wave capabilities avoid smearing, which is common in mid-wave technologies. Mid-wave takes a thousand times longer to produce an image, Watson estimated, creating the smearing effect as conditions outside of an aircraft change rapidly.

Lockheed Martin currently has fitted the Pathfinder to a helmet-mounted display in an HH-60L Black Hawk at Fort Eustis, Va., for testing. The Black Hawk has two helmets—one for the left seat and one for the right—and night vision goggles and FLIR capabilities. The helmets are of a symbology-only mode where the pilot gets a heads-up display wherever he likes with a transparent visor.

Pathfinder also offers high visual acuity with a 52 by 30 degree field of view, Watson noted, which puts it very close to normal visibility. So Pathfinder provides performance equal to the best operating conditions for night vision goggles without any obstructions.

"Its performance would rival that of the goggles in their best illumination environment, namely with a full moon and a clear sky overhead," Watson stated. "Picture your very best night vision goggle night, and we can give you that capability all of the time, independent of illumination. That's key in applications like in some of the current conflicts where you have high mountain ranges where it gets really dark because they are masking illumination sources like the moon. The FLIR doesn't really care. It still produces a very clean, crisp highperformance image in that environment."

With the proliferation of night vision goggles among U.S. adversaries, Pathfinder also provides an alternative for gaining an edge in night vision that has been lost in recent years, Watson contended.

CLEARING THE DIRT

While equipping aircraft with technologies to guide pilots through adverse conditions captures the imagination, different approaches are available to simply clear dust from landing pads and thus provide more visibility to helicopter crews. Soilworks LLC, based in Gilbert, Ariz., manufactures five different products for ensuring that helipads remain visible, said Chad Falkenberg, Soilworks president.

"Soiltac and Powdered Soiltac are ecosafe, biodegradable, high-performance, copolymers engineered from nanotechnology that are used to stabilize and solidify helipads on any soil or aggregate," Falkenberg stated. "Once applied to the helipad, the copolymer molecules coalesce, forming bonds between the soil or aggregate particles."

Soiltac, which is biodegradable, forms a water-resistant, flexible shield, which can last weeks or even years, on a helipad. The company also offers a product called Gorilla-Snot, which is a cheaper version of Soiltac for circumstances where the longevity of the shield is not a top priority.

Another treatment produced by Soilworks was originally developed by the Naval Research Laboratory (NRL). The NRL's Surtac, now under exclusive license to Soilworks, is a liquid that forms a crust on helipads. The liquid is actually made up of off-the-shelf items available globally in any grocery store, Falkenberg noted, and they are blended using basic field mixing techniques.

The hard surface that results from spraying Surtac on a helipad stands up to a helicopter's rotorwash and landing gear to prevent the generation of any dust. Warfighters can dissolve Surtac away with water once they are through with the surface it creates.

The final product offered by Soilworks is called Durasoil, which was developed for handling dust control at forward arming and refueling points and on helipads. It is an organic fluid that works differently than Soilworks' other offerings because it does not form a crust of any sort. Instead, it controls dust without the need to cure, enabling helicopters to land on it immediately after application. Helicopters can disturb Durasoil, which is clear and odorless, with their rotors but it will prevent dust from obstructing the view of crews as the aircraft land.

Durasoil is environmentally safe and works even in freezing or wet conditions, Falkenberg emphasized.

SHIPBOARD LANDING

Landing on stable terrain is difficult enough in brownout or whiteout conditions, but imagine trying to land on a moving aircraft carrier in less-than-optimal weather. The U.S. Navy has

imagined it and has decided it really needs the Joint Precision Approach and Landing System (JPALS) to guide its pilots through the dark with global positioning system information.

The Navy has awarded a contract to Raytheon and Rockwell Collins to develop the system with first prototypes to be delivered around 2011, Randy DeKlotz, Rockwell Collins program manager for maritime systems, told *SOTECH*.

"JPALS utilizes global positioning system information on both the aircraft and the ship to triangulate positioning; then there is a communication system that passes that information back and forth so the aircraft and the aircraft carrier are in synch with regard to where each one is at. As they get closer and closer together, it becomes more critical that the information is exact," DeKlotz explained.

"Landing on an aircraft carrier is very different from landing on stationary earth," he continued. "An aircraft carrier is moving in about seven different directions— side-to-side, up-and-down, back-and-forth, sway, pitch and yaw. All of those things cause that landing position to be always moving."

So an aircraft landing on a carrier deck has a moving target to acquire when it is looking for the landing bar that will keep it on the ship. Ideally, JPALS would guide an aircraft down to that position without relying on the pilot's eyesight, DeKlotz said.

The Navy will test JPALS initially on a CH-47 and F/A-18 before entering any production phase. But eventually JPALS would fit on any aircraft that must land on an aircraft carrier or any other ship, DeKlotz noted.

The first increment of JPALS, in a contract worth $94 million to Rockwell Collins, has the goal of producing a joint operational capability for U.S. forces to equip all airframes with precision GPS equipment to operate from ships under various meteorological and terrain conditions. Rockwell Collins has responsibility for providing the GPS and communications subsystems along with systems engineering and test and logistics support.

LANDING AID

Sometimes pilots need to be able to see exactly where to land, but they don't have particularly sophisticated guidance systems in their aircraft to take them there. Under these conditions, it is sometimes expedient to provide landing aids on the ground to guide pilots to the appropriate landing locations. TVI Corp., based in Glenn Dale, Md., has developed a solution called Infrared Raised Angle Marking System (IRAMS) for such conditions.

"This particular product originated from a couple of different technologies that we had in other products," Daren Olsen, TVI director of programs, told *SOTECH*. "We have long manufactured a lot of active thermal panels that are used at gunnery ranges for nighttime live-fire exercises. These are heated panels that gunneries can use to see through thermal imagers for firing exercises. That's one of the components that make up the IRAMS panels."

Another component is an articulating frame for 3-D thermal targets. TVI incorporated the frame technology into some of its shelter systems. The company then developed an articulating A-frame that became the base for the panel set in IRAMS.

So IRAMS is a very portable, compact package that expands into a large visible frame set that pilots can see clearly from a far distance, Olsen said.

The panels utilize thermal and nearinfrared technology in both passive and active configurations. They provide a hazard marker as a directional approach for Apache crews. The articulating frame stands 8 feet tall, and the panels and incandescent lights provide a means for Apache crews to boresight their guns.

The sets come in a series of numbered panels that permit the Army to arrange refueling and rearming locations with four or eight panels. The panels, measuring 2 feet by 2 feet, provide a clear marker during the day. Depending on nighttime or weather conditions, the panels can provide illumination in a passive mode as pilots spot them through their night vision goggles or FLIRs. In the event of high winds blowing sand or heavy fog, the panels can switch to an active mode where they use near-infrared light to illuminate the number on the panel.

So far, TVI has sold the panels mostly to the 21st Calvary at Fort Hood. The calvary uses the equipment for trainings for all crews passing through its doors, Olsen said.

“As opposed to what the crews are currently using right now, this was designed as a standard approach that could be used universally to eliminate the use of chemsticks. It’s much more effective than using chem-sticks. It’s a lot more effective than some of the other options used in the past for boresighting,” Olsen commented.

TVI is aiming to sell IRAMS as a standard equipment item for forward arming and refueling points, whereas it is currently more popular with individual battalions.