



# Lockheed Martin Management Association Retirees Newsletter

*Looking Forward Towards A Wonderful Retiree Future!*

NOVEMBER 2013

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### Evelyn Limbert Obituary

Nov. 20, 1920 - Sept. 28, 2013

Evelyn Limbert, a resident Sunnyvale for 57 years, passed away peacefully on Sept. 28th. Born in Akron, Ohio to Michael and Mary Rusinko, she married Robert Limbert and they were employed by Lockheed in Burbank, CA. In 1956 they relocated to Sunnyvale and worked at Lockheed until their retirement. Evelyn's greatest joys were golfing and watching sports. She was a devout Catholic and member of Resurrection Parish. She is survived by their daughter Olivia Reiff and family, also by several nieces and nephews. Friends are invited to the Funeral Mass, Monday Oct. 7, 10:00a.m. at Church of the Resurrection, 725 Cascade Ave., Sunnyvale. Interment at Gate of Heaven Cemetery, Los Altos.

### Emma Pinard

Ima Pinard (Marv's wife) passed away peacefully on Sat 10/26/13. Services

## Needed: Staff Help

LMMAR needs volunteers to help keep LMMAR going. We particularly need a secretary and a newsletter editor.

If you think you can help please contact:

Norm Dhom, Membership Chair – (408) 732-2742

Jerry Vaughan, Treasurer – (408) 985-2708

will be held on 16 November at 11:00a.m. at St. John Lutheran Church on 581 East Fremont Avenue in Sunnyvale, CA (408) 739 2625

Thelma fought a valiant battle against cancer for ten years. In all that time, I never heard her exude anything but a positive attitude. She and Marv attended many Lockheed Old Timers events as well as those of the Lunch Bunch, and LMMAR, Lockheed Martin retirees organizations. Thelma will be missed by all of us.

Please keep Thelma's family in your thoughts and prayers as they struggle with the final arrangements. For those will comfort the family at this time and fill their minds and hearts with warm loving memories of the time they shared together. Cards of condolence may be sent to: Marvin A. Pinard, 918 Inverness Way, Sunnyvale, CA 94087-4933

### Bosphorus Tunnel

Istanbul (AFP) - Turkey unveils Tuesday, 10/29, the world's first sea tunnel connecting two continents, fulfilling a sultan's dream 150 years ago in a three-billion-euro mega project driven by the Islamic-rooted government.

The 13.6-kilometre (8.5 mile) long tunnel linking Istanbul's European and Asian sides includes an immersed tube tunnel which officials say is the world's deepest at 60 metres (nearly 200 feet) below the seabed.

The inauguration of the ambitious scheme – dubbed "the project of the century" by the government – coin-



cides with the 90th anniversary of the founding of modern Turkey.

"Turkey will celebrate two feasts together," Transport Minister Binali Yildirim said earlier this month.

"We will mark the 90th anniversary of the republic on October 29 and also realise a one-and-a-half century dream of a major rail tunnel project in Istanbul."

The tunnel in the country's main gateway city is part of a larger "Marmaray" project that also includes an upgrade of existing suburban train lines to create a 76-kilometre (47-mile) line that links the two continents.

The idea was first floated by Ottoman sultan Abdoul Medjid in 1860 but technical equipment at the time was not good enough to take the project further.

However the desire to build an under-sea tunnel grew stronger in the 1980s and studies also showed that such a tunnel would be feasible and cost-effective.

Prime Minister Recep Tayyip Erdogan, a former mayor of Istanbul, revived the plan in 2004 as one of his mega projects for the bustling city of 16 million people – which also include a third airport, a third bridge across the Bosphorus and a canal parallel to the international waterway to ease traffic.

His ambitions were one cause for the massive anti-government protests that swept the country in June, with local residents complaining the premier's urban development plans were forcing people from their homes and destroying green space.

Erdogan's critics accuse him of bringing forward the inauguration of the Bosphorus tunnel in time for municipal elections in March 2014.

The project will not be fully operational immediately and construction is expected to continue for several more years.

Japan's Prime Minister Shinzo Abe will be present at the official opening ceremony at 1300 GMT, as the Japan Bank for International Cooperation was the main financier contributing 735 million euros (\$1 billion) to the project.

Construction of the tunnel started in 2004 and had been scheduled to take four years but was delayed after a series of major archaeological discoveries.

Some 40,000 objects were excavated from the site, notably a cemetery of some 30 Byzantine ships, which is the largest known medieval fleet.



But these unexpected finds eventually frustrated Erdogan, who complained two years ago that artefacts were trumping his plans to transform Istanbul's cityscape.

"First (they said) there was archaeological stuff, then it was clay pots, then this, then that. Is any of this stuff more important than people?"

Transport is a major problem in Istanbul, and each day two million people cross the Bosphorus via two usually jammed bridges.

"While creating a transportation axis between the east and west points of the city, I believe it will soothe the problem... with 150,000 passenger capacity per hour," said Istanbul's mayor Kadir Topbas.

#### Polio Outbreak Confirmed in Syria

Geneva (AFP) - The UN health agency on Tuesday (10/29) confirmed an outbreak of polio in war-torn Syria, which had been free of the crippling disease

since 1999, and said it feared it would spread.

Oliver Rosenbauer, spokesman for the World Health Organization's anti-polio division, told reporters that laboratory tests had confirmed the presence of the disease in 10 out of 22 suspected cases reported almost two weeks ago.

All 22 children were stricken with acute flaccid paralysis, which is the symptom of a number of different diseases, including polio.

"Out 10 of those cases, they've isolated wild polio virus type one," Rosenbauer said.

"The other 12 are still being investigated," he added, saying test results were expected in coming days.

The cases were clustered in the north-eastern Deir Al Zour province, and all affected children under the age of two.

"There are no additional 'hot' cases that we know of. Of course disease surveillance is now ongoing across Syria and neighbouring countries as well, to look for other acute flaccid paralysis cases," said Rosenbauer.

The next step is to analyse the genetic code of the virus to try to track its source.

"This is a communicable disease, and with population movements it can travel to other areas, and so the risk is high of a spread across the region of course," Rosenbauer warned.

Last week, as they waited for confirmation of the cases, aid agencies and Syrian health authorities stepped up efforts to vaccinate 2.4 million children against polio, as well as measles, mumps and rubella.

The UN says that 500,000 children in Syria have not been vaccinated against polio in the past two years due to insecurity.

Before the Syria conflict, around 95 percent of all Syrian children were vaccinated.

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Rosenbauer said that all the children who have caught the virus in Deir Al Zour appeared to have never been vaccinated against polio, or had not received a full course of vaccine.

Some 115,000 people have been killed in Syria and millions driven from their homes since a brutal crackdown on Arab Spring-inspired protests in March 2011 escalated into civil war.

**Boeing CHAMP Missile**

ST. LOUIS, Sept. 22, 2011 – The Boeing Company [NYSE: BA] and the U.S. Air Force Research Laboratory Counter-electronics High-powered Microwave Advanced Missile Project (CHAMP) today announced that they successfully completed the missile's first flight test earlier this year at the Utah Test and Training Range at Hill Air Force Base.

CHAMP is a nonlethal alternative to kinetic weapons that neutralizes electronic targets. It would allow the military to focus on these targets while minimizing or eliminating collateral damage.

The CHAMP missile pointed at a set of simulated targets, confirming that the missile could be controlled and timed while using a High-powered Microwave (HPM) system against multiple targets and locations. The software used was identical to the software required for a vehicle with a fully integrated HPM system on board.

"It was as close to the real thing as we could get for this test," said Keith Coleman, CHAMP program manager for Boeing Phantom Works. "This demonstration, which brings together the Air Force Research Laboratory's directed energy technology and Boeing's missile design, sets the stage for a new breed of nonlethal but highly effective weapon systems."

The three-year, \$38 million joint capability technology demonstration program includes ground and flight demonstrations that focus on technology integration risk reduction and mili-

tary utility. More tests are scheduled for later this year.

Boeing received the contract in April 2009. As the prime contractor, Boeing provides the airborne platform and serves as the system integrator. Albuquerque, N.M.-based Ktech Corp. – the primary subcontractor – supplies the HPM source. Sandia National Laboratories provides the pulse power system under a separate contract with the Air Force Research Laboratory.

**Old Timers Pizza Lunch**

Tuesday, November 12, 2013- next week.  
 TIME: 11:30 a.m.  
 PLACE: Pizza Depot –919 E Duane Ave., Sunnyvale, CA  
 Ph: 408. 245.7760  
 COST: \$8.12 - For the Buffet - Order other items at menu prices\*

Join us for an 'all you can eat' buffet for \$8.12 which includes a soft drink and the tax. The buffet features a salad bar, baked chicken, pasta, pizza, a mexican dish, and garlic bread, etc.

Money will not be collected for the buffet or menu orders. In order to get the \$8.12 price on the buffet, you will need a name tag from Flo Fiance to let the owner know to charge \$8.12. \*If you order from the menu you pay the cashier the menu price. Pizza Depot serves hamburgers, sandwiches, etc.

Directions to the Pizza Depot in Sunnyvale:

Once you are on the Bayshore Fwy. (101) from the North, Turn Right on Lawrence Expressway, South. Make a right onto Duane Ave. Directions once you are on the Bayshore Fwy. (101) from the South, turn Left on Lawrence Expressway, South. Make a right onto Duane Ave.

Visit your website for more information & a map – [www.lockheedoldtimers.org](http://www.lockheedoldtimers.org)

Everyone is welcome. Your Old Timers Committee is looking forward to seeing you on Tuesday the 12th .

Fred Anderson 408.265.6097 John Ikner 408.737.2649  
 Danny Dong 408.241.3243 Sheryl Meininger 408.265.6607  
 Ron Duffin 408.997.7528 David & Alice Ray 408.252.7101  
 Flo Fiance 408.446.1873 Wayne & Patsy Smith 408.268.8351  
 Ruth Hagan 408.739.8237 Jay Wheeler 408.259.0252  
 Bill Hammerlund 408.371.6899 Lucille Wilson 408.225.9566  
 Jim Haynes 408.729.3152 November 01, 2013

**Son of Blackbird**

Ever since Lockheed's unsurpassed SR-71 Blackbird was retired from U.S. Air Force service almost two decades ago, the perennial question has been: Will it ever be succeeded by a new-generation, higher-speed aircraft and, if so, when?

That is, until now. After years of silence on the subject, Lockheed Martin's Skunk Works has revealed exclusively to AW&ST details of long-running plans for what it describes as an affordable hypersonic intelligence, surveillance and reconnaissance (ISR) and strike platform that could enter development in demonstrator form as soon as 2018. Dubbed the SR-72, the twin-engine aircraft is designed for a Mach 6 cruise, around twice the speed of its forebear, and will have the optional capability to strike targets.

Guided by the U.S. Air Force's long-term hypersonic road map, the SR-72 is designed to fill what are perceived by defense planners as growing gaps in coverage of fast-reaction intelligence by the plethora of satellites, subsonic manned and unmanned platforms meant to replace the SR-71. Potentially dangerous and increasingly mobile threats are emerging in areas of denied or contested airspace, in countries with sophisti-

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cated air defenses and detailed knowledge of satellite movements.

A vehicle penetrating at high altitude and Mach 6, a speed viewed by Lockheed Martin as the “sweet spot” for practical air-breathing hypersonics, is expected to survive where even stealthy, advanced subsonic or supersonic aircraft and unmanned vehicles might not. Moreover, an armed ISR platform would also have the ability to strike targets before they could hide.

Although there has been evidence to suggest that work on various classified successors to the SR-71, or some of its roles, has been attempted, none of the tantalizing signs have materialized into anything substantial. Outside of the black world, this has always been relatively easy to explain. Though few question the compelling military imperative for high speed ISR capability, the astronomical development costs have made the notion a virtual non-starter.

But now Lockheed Martin believes it has the answer. “The Skunk Works has been working with Aerojet Rocketdyne for the past seven years to develop a method to integrate an off-the-shelf turbine with a scramjet to power the aircraft from standstill to Mach 6 plus,” says Brad Leland, portfolio manager for air-breathing hypersonic technologies. “Our approach builds on HTV-3X, but this extends a lot beyond that and addresses the one key technical issue that remained on that program: the high-speed turbine engine,” he adds, referring to the U.S. Air Force/Defense Advanced Research Projects Agency (Darpa) reusable hypersonic demonstrator canceled in 2008.

The concept of a reusable hypersonic vehicle was an outgrowth of Darpa’s Falcon program, which included development of small launch vehicles, common aero vehicles (CAV) and a hypersonic cruise vehicle (HCV). As structural and aerodynamic technologies for both the CAV and HCV needed testing, Lockheed Martin was funded to devel-

op a series of unpowered hypersonic test vehicles (HTV).

In the midst of these developments, as part of a refocus on space in 2004, NASA canceled almost all hypersonic research, including work on the X-43C combined-cycle propulsion demonstrator. The Darpa HTV effort was therefore extended to include a third HTV, the powered HTV-3X, which was to take off from a runway on turbojet power, accelerate to Mach 6 using a scramjet and return to land.

Despite never progressing to what Leland describes as a planned -HTV-3X follow-on demonstrator that “never was,” called the Blackswift, the conceptual design work led to “several key accomplishments which we didn’t advertise too much,” he notes. “It produced an aircraft configuration that could controllably take off, accelerate through subsonic, supersonic, transonic and hypersonic speeds. It was controllable and kept the pointy end forward,” adds Leland.

Fundamental lessons were learned, particularly about flight control systems that could maintain stability through the transonic speed regime. Lockheed Martin’s work proved the configuration could “take off without departing,” Leland notes. “We were able to drive down the takeoff speed and keep it stable and controllable. We proved all that in a whole series of wind-tunnel tests.”

Just as importantly, the Skunk Works design team developed a methodology for integrating a working, practical turbine-based combined cycle (TBCC) propulsion system. “Before that, it was all cartoons,” Leland says. “We actually developed a way of transforming it from a turbojet to a ramjet and back. We did a lot of tests to prove it out, including the first mode-transition demonstration.” The Skunk Works conducted subscale ground tests of the TBCC under the Facet program, which combined a small high-Mach turbojet with a dual-mode ramjet/scramjet, and the two sharing an axisymmetric inlet and nozzle.

Meanwhile, the U.S. Air Force Research Laboratory’s parallel HiSTED (High-Speed Turbine Engine Demonstration) program essentially failed to produce a small turbojet capable of speeds up to Mach 4 in a TBCC. “The high-speed turbine engine was the one technical issue remaining. Frankly, they just weren’t ready,” recalls Leland. This left the Skunk Work designers with a familiar problem: how to bridge the gap between the Mach 2.5 maximum speed of current-production turbine engines and the Mach 3-3.5 takeover speed of the ramjet/scramjet. “We call it the thrust chasm around Mach 3,” he adds.

Although further studies were conducted after the demise of the HTV-3X under the follow-on Darpa Mode-Transition program, that fell by the wayside, too, after completion of a TBCC engine model in 2009-10. So, Lockheed Martin and Aerojet Rocketdyne “sat down as two companies and asked ourselves, ‘Can we make it work? What are we still missing?’” says Leland. “A Mach 4 turbine is what gets you there, and we’ve been working with Rocketdyne on this problem for the last seven years.”

Finally, he says, the two achieved a design breakthrough that will enable the development of a viable hypersonic SR-71 replacement. “We have developed a way to work with an off-the-shelf fighter-class engine like the F100/F110,” notes Leland. The work, which includes modifying the ramjet to adapt to a lower takeover speed, is “the key enabler to make this airplane practical, and to making it both near-term and affordable,” he explains. “Even if the HiSTED engines were successful, and even if Blackswift flew, we’d have had to scale up those tiny turbines, and that would have cost billions.”

Lockheed will not disclose its chosen method of bridging the thrust chasm. The company funded research and development, and “our approach is proprietary,” says Leland, adding that

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he cannot go into details. Several concepts are known, however, to be ripe for larger-scale testing, including various pre-cooler methods that mass-inject cooler flow into the compressor to boost performance. Other concepts that augment the engine power include the “hyperburner,” an augmentor that starts as an afterburner and transitions to a ramjet as Mach number increases. Aerojet, which acquired Rocketdyne earlier this year, has also floated the option of a rocket-augmented ejector ramjet as another means of providing seamless propulsion to Mach 6.

Although details of the proposed thrust-augmentation concept remain under wraps, Leland says a large part of a successfully integrated mode-transition design is the inlet. “That’s because you have to keep two compressor systems [ramjet and turbine] working stably. Both will run in parallel,” he adds.

Lockheed has run scaled tests on components. “The next step would be to put it through a series of tests or critical demonstrations,” Leland says. “We are ready for those critical demonstrations, and we could be ready to do such a demonstration aircraft in 2018. That would be the beginning of building and running complete critical demonstrations. As of now, there are no technologies to be invented. We are ready to proceed—the only thing holding us back is the perception that [hypersonics] is always expensive, large and exotic.”

The 2018 time line is determined by the potential schedule for the high-speed strike weapon (HSSW), a U.S. hypersonic missile program taking shape under the Air Force and Darpa (see page 36). “We can do critical demonstrations between now and then, but we don’t believe it will be until HSSW flies and puts to bed any questions about this technology, and whether we can truly make these, that the confidence will be there.” In spite of the recent success of demon-

stration efforts, such as the X-51A Waverider, Leland observes that “hypersonics still has a bit of a giggle factor.” The timing also dovetails with the Air Force hypersonic road map, which calls for efforts to support development of a hypersonic strike weapon by 2020 and a penetrating, regional ISR aircraft by 2030 (AW&ST Nov. 26, 2012, p. 40). Key requirements for the high-speed ISR/strike aircraft is the ability to survive a “day without space”—communication and navigation satellites—and to be able to penetrate denied areas. With a TBCC propulsion system, the Air Force has pushed for increasingly greater speeds since defining Mach 4 at initial planning meetings in December 2010. The latest requirements are thought to be at least a Mach 5-plus cruise speed and operation from a conventional runway.

The path to the SR-72 would begin with an optionally piloted flight research vehicle (FRV), measuring around 60 ft. long and powered by a single, but full-scale, propulsion flowpath. “The demonstrator is about the size of the F-22, single-engined and could fly for several minutes at Mach 6,” says Leland. The outline plan for the operational vehicle, the SR-72, is a twin-engine unmanned aircraft over 100 ft. long (see artist’s concept on page 20). “It will be about the size of the SR-71 and have the same range, but have twice the speed,” he adds. The FRV would start in 2018 and fly in 2023. “We would be ready to launch the SR-72 shortly after and could be in service by 2030,” Leland says.

According to Al Romig, Skunk Works engineering and advanced systems vice president, “speed is the new stealth.” This is perhaps just as well, given the inherent challenges involved in reducing the signature of hypersonic vehicles. With large engine inlets and aerodynamic requirements overriding most considerations, the SR-72 concept shows little in the way of stealthy planform alignment. Although the surfaces could be coated with radar-absorbing material, the requirement

for thermal protection along sharp leading edges is likely to be a complicating factor. Like the HTV-3X, the vehicle may also feature hot metallic leading edges and a “hot/warm” metallic primary structure designed to handle the high thermal flux loads.

The deep nacelles, mounted close inboard, indicate the “over-under combined cycle” engine configuration outlined for the HTV-3X, as well as integrated inward-turning turbo-ramjet inlets. “One of the differences with this demonstrator compared to the HTV-3X is that with that, we were limited to small turbines with a low-drag design,” Leland says. “With fighter engines, we accelerate much more briskly. It’s a significant improvement in adding margins. It is also very important [that] you have a common inlet and nozzle because of the significant amount of spillage drag in the inlet and the base drag in the nozzle.”

Aerodynamically, the forebody appears to be shaped for inlet compression at high speed, but without the characteristic stepped “wave-rider” configuration of the X-51A. “We are not advocates of wave riders,” Leland says. “We found that, in order for a wave rider to pay off, you have to be at cruise and be burning most of your fuel at cruise. But these designs burn most fuel as they accelerate, so you want an efficient vehicle that gets you to cruise. You end up with a vehicle that is hard to take off and land, has little fuel volume and high transonic drag.”

The planform is characterized by chines that blend into a sharply swept delta extending back roughly halfway along the hump-backed fuselage. The chine and delta are likely designed to provide increased directional stability as well as a larger amount of lift at high cruise speeds. Outboard of the engine inlets, the leading-edge angle abruptly aligns with the fuselage before the wing extends into a trapezoid. The angle of the cranked wing would provide vortex lift to assist with low-speed flight.

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NOVEMBER, 2013

## **Activity Calendar**

- **LMMAR Executive Board Meeting.** First Monday of each month unless holiday conflict, then second Monday. 9:30 a.m. Bldg. 157-Front Lobby Conference Room.
- **LMMAR Newsletter Mailing Session.** Volunteers needed. Second Thursday of each month. 9:30 a.m. Bldg. 157-Litrium. Contact Norm Dhom (408) 732-2742.
- **LMMAR Bridge Card Players.** Join the fun! Every Tuesday and Thursday, 12:00 noon at the Willow Park Condominiums located at the NE corner of Moffet Blvd. and Middlefield Road in Mountain View. Entrance is from Moffet Blvd. Contact Dave Himmelblau, 'phone No. 650 968-1121.
- **Lockheed Martin Blood Bank.** Second Wednesday of each month. 8:00 a.m. - 3:00 p.m. Bldg. 163. LMMAR Contact Norm Dhom (408) 732-2742.
- **Lockheed Martin Retirees Investment Group (LMRIG).** Meets last Thursday of each month, 1:00-2:00 p.m. in B163 at the corner of J Street and 1st Ave. (Employee Connection Building). Dues are \$2. Contact Don Kinell (650) 948-1520 or Martin Abelow (408) 253-6924. Join us for lunch in the B-157 cafeteria prior to the meeting between 11:40-12:40.

For your financial needs, please contact Star One Credit Union at [www.starone.org](http://www.starone.org) or (866) 543-5202 toll free.

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