ON OSPREY SAFETY AND SUSTAINABILITY

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Preface

This report highlights articles we have published this year which focus on the Osprey from a safety and sustainability perspective.

These seems to be a cottage industry of critics of the aircraft who focus primarily on the perceived safety and reliability record.

But this perspective is presented frequently without reference to the combat record of the aircraft or the con-ops innovations enabled by the aircraft which have enabled warfighters to land in combat areas much more safely than on rotorcraft,

My book entitled *A Tiltrotor Enterprise: From Iraq to the Future* will be published next year. The book is built around the many interviews and experiences I have had with the enterprise since 2007.

This report is a harbinger of the forthcoming book.

ONE

Looking Back and Looking Forward with the Osprey: The Perspective of LtGen (Retired) Heckl

September 2024

In August 2024, LtGen Heckl retired from the USMC after 37 years of service. He has held several command positions and has a wealth of combat experience. I conducted series of interviews with him in which we discussed both his experience and his judgement with regard to the way ahead for the joint force as it addresses the challenges of the evolving strategic environment.

In the first interview in that series, published September 16, 2024, we focused on his experience with the Osprey and how he views its role and impact on USMC operations. We discussed this from the standpoint of his own experience with the aircraft beginning with his initial engagement with the program, his deployment to Iraq and then his experience with the aircraft as it has evolved over time within the context of USMC operations.

This interview provides a good place to start when discussing the tiltrotor enterprise.

We started with his initial involvement with the aircraft. He came to the Osprey from a CH-46 background and operations with that aircraft in a variety of combat situations.

Heckl noted that when he left as at MAWTS-1 instructor in 1999, he had been selected as one of the initial members of the new VMMT-204 squadron to replace HMT-204.

There were two accidents involving the aircraft in 2000 which slowed down the process of launching VMMT-204 so Heckl left to deploy with HMM-263 which formed the Aviation Combat Element for the 24th Marine Expeditionary Unit and participated in the initial combat operations in Operation Iraqi Freedom.[1]

Heckl then came back to Washington where he was attached to the office of the Deputy Commandant for Aviation, Headquarters Marine Corps, where he worked as the requirements officer for the Osprey. He first flew the aircraft in May 2000 and by the time he was back in Washington he had accumulated 160 hours on the aircraft.

Heckl was now a Major working for the Deputy Commandant for Aviation. And during that time Col Glen Walters, who later became the 34th Assistant Commandant of the Marine Corps from 2016 to 2019, was the Commanding Officer of VMX-22 and putting the Osprey through Operational Evaluation, specifically Operational Test-IIG, testing the platforms operational effectiveness and suitability.

I dealt often with VMX-22 in the past, but it has now become VMX-1.

As one source described VMX-22:

"Marine Tiltrotor Operational Test and Evaluation Squadron Twenty-Two (VMX-22) is a United States Marine Corps tiltrotor squadron consisting of MV-22 Osprey aircraft. The squadron, known as the "Argonauts", is based at Marine Corps Air Station New River, North Carolina. VMX-22 stood up in August 2003 and reports to the Commander, Operational Test and Evaluation Force (COMOPTEVFOR), who in turn reports test data and results to the Office of the Secretary of Defense, Director, Operational Test and Evaluation."[2]

Heckl then got selected for command of an Osprey

squadron which deployed as the second squadron into Iraq in 2008. It was a seven-month deployment to Al Assad Airbase in Iraq and the deployment spanned the brutal summer months and the aircraft according to Heckl "performed spectacularly" primarily a function of hard work by the maintenance Marines.

I asked him to take us back to that initial period to remember what were the expectations at the time with regard to the initial Osprey deployments.

"We knew that the aircraft had unique speed, range, payload flexibility, unique survivability capabilities.

"But our awareness of what it could do came with the use of the aircraft in real world situations.

"For example, Senator Barack Obama came over with Sec Def Hagel and Senator Jack Reed. We had to support Senator Obama moving around. I launched five airplanes. I was in one of them. But we only needed three of them but we launched backups to be ready.

"We had to land at a Forward Operating Base (FOB) just east of the Baghdad International Airport. We had to do a vertical landing in sequence with three aircraft to carry all of the people involved.

"We flew all the way across the country of Iraq, into Jordan, and went to Marka International Airport to drop off Senator Obama. We landed. We didn't shut down, didn't get gas, and we were on the deck for probably 20-30 minutes after dropping him off and we took off again, flew back into Iraq and had enough gas to service two assault support requests before we got gas.

"If we were using CH-46s that would have taken us two days and several landings for gas.

"That was an eye opener for me, and I thought back to when we invaded Iraq back in 2003. Flying the frog, I launched off the USS Nassau. I barely made it to Jabala airfield, before we had to get gas. And here, the V 22 was

traversing almost the entire width of Iraq, and covering a third of the country of Jordan, and then back into Iraq on one bag of fuel. Just amazing.

"The other part about the airplane that we realized was survivability. So back then, the zones were designated a color code. Green is obviously good. Black was the worst. So if you had a black zone, you could go only go in at night. The Osprey operated in the black zones comfortably.

"We would ingress to the objective while we wore night vision goggles. And then at the pre brief point, we would pull the thrust control lever, the TCL or the gas pedal, essentially to flight idle and then we would just start the slow, gradual spiral.

"We had very minimal infrared (IR) signature. The most significant contributor to IR signature is hot gas impingement. Hot gas comes out of the 46 or a 53 and heats up the surface of the aircraft.

"With the V-22 its two big heat generators are the engines. Those two powerful engines are located on the wing tips, sitting at the dead center of a 38-foot proprotor that's blowing hurricane force air around it. And both engines have full time infrared suppressors. And not to mention that while you're doing that, your acoustical signature is virtually eliminated, you're just basically gliding on the wing. You got down to a certain altitude, and you'd level off, maintaining at or below 200 feet AGL above ground level.

"So we stay out of the small arms fire and RPG envelope, and reduced our signature to MANPADS. So the heat signature is low, the acoustical signatures is low, and then less than a mile from the landing zone is when you actually have to start putting in power to do a vertical landing.

"In other words, the survivability is just phenomenal. Of course, the systems on the aircraft since then have been upgraded. The automation has progressed by leaps and

bounds. There is virtually no LZ the aircraft can not land in regardless of dust condition."

I pointed out that the discussion of Osprey safety – which is about the same level as most rotorcraft – has completely ignored the impact of the aircraft on survivability. How many lives have been saved by the tiltrotor aircraft and how it operates is not a common subject.

Heckl agreed completely and argued that safety is a factor in survivability, but the focus has to be on survivability.

"As a former MAWTS-1 instructor and then as CO, our focus was very much on the Tactics, Techniques and Procedures (TTPs) for enhanced survivability. And with regard to rotorcraft, a key survivability challenge comes with regard to ingress and egress from a LZ. With the Osprey, we can approach or leave the LZ from a variety of points differently from rotorcraft and with speed they simply do not have. In Iraq, we would go through the small arms and RPG envelope in seconds."

In 2010, Heckl became the CO of MAWTS-1 where the first class of Ospreys were integrated into the TTPs being worked at this unique warfighting center.

My colleague Ed Timperlake and I have recently published a book on MAWTS-1 and as LtGen (retired) George Trautman, former DCA, commented about MAWTS-1: "How did MAWTS-1 evolve to become such an indispensable pillar within the Marine Corps? Its significance lies in its role as the premier training unit for Weapons and Tactics instruction, where it refines and disseminates cutting-edge concepts of employment – often with new weapons that have potential capabilities never previously imagined.

"By continually adapting to emerging threats and technological advancements, MAWTS-1 ensures that Marine aviators are equipped with the skills and knowledge necessary to excel in the ever-evolving landscape of modern warfare. The squadron's contributions extend beyond training, influencing

the development of new doctrines and fostering a culture of innovation within the Marine Corps aviation community.

"In essence, MAWTS-1 serves as a linchpin in maintaining the Marine Corps' tactical edge, preparing its aviators for the challenges of today and the uncertainties of tomorrow."

Heckl argued that the coming of the Osprey to MAWTS-1 in 2010 was part of honing the warfighting edge of the USMC going ahead. "Professionally, sound, and tactically planned missions are inherently safe. That is what we focused on in MAWTS-1. Safety is part of survivability.

"For a combat pilot, safety is part of the survivability issue. And that's why I love MAWTS-1.

"We now had the V-22 collaborating with all the other rotorcraft and for me V 22 needs to be discussed in terms of operating with the KC-130Js. I would express caution for anybody to discuss V 22 without every other sentence talking about KC-130J. It is a phenomenal workhorse and when paired with the V-22 creates an incredible operational envelope for the Marines."

His next assignments after leaving MAWTS-1 in 2011 and until his becoming the commander of 2nd Marine Air Wing in 2018 included the following: J3 Director of Operations, United States Forces- Afghanistan (USFOR-A), Kabul, Afghanistan, Military Assistant to the Secretary of the Navy, Assistant Deputy Commandant for Aviation, HQMC Aviation Department, Washington DC, and Chief of Staff, Naval Striking and Support Forces NATO (STRIKFORNATO), Lisbon, Portugal.

For the purposes of this interview, we next focused on his time serving as the Military Assistant to the Secretary of the Navy. Heckl related his experience in working with the Sec Nav and introducing him to the Osprey and its impact. And this experience would lead the Navy to start seriously its journey to acquire the aircraft for the replace-

ment of the C-2 in the support role for the large deck carriers.

This is a story I have never heard before and frankly of great interest to the question of building out what would become a tiltrotor enterprise. At the time during this tour in the Pentagon, the Sec Nav was Ray Mabus and the CNO was Admiral Greenert.

According to Heckl: "I am now a Colonel, and the Sec Nav wants to go out on the Bush to see the X-47 unmanned platform operating off of the large deck carrier. The staff is organizing the visit whereby he flies by aircraft to Norfolk and then take the C-2 aircraft onto the carrier.

"I observe that the Secretary is not pleased with how much time this going to take. I suggested to the Secretary that there was a way to go from the Pentagon helo pad directly to the Bush. I went to meet LtGen Schmidle, DCA, and he offered an Osprey. The Secretary used the aircraft and when he returned to the Pentagon, he turned to the CNO and asked: "Why are we not buying this?"

Heckl went on to work with LtGen Davis as assistant DCA, Commander of 2nd MAW, CG of 1 MEF and retired as Commanding General Marine Corps Combat Development Command. In those positions, he saw the Osprey evolved into a multi-mission aircraft with an ability to perform very flexible roles with its roll on and roll off capabilities. I talked with Heckl when he held all of those positions about aviation and combat development issues and have published these interviews throughout the years.

But we concluded by discussing the growing relevance of the Osprey to the joint force and the USMC with the focus increasingly being upon distributed operations.

According to Heckl: "Logistics, C2 and maneuver are three key warfighting functions. The Osprey can deliver all three to a distributed force in unique ways. We have only scratched the surface of what this aircraft can deliver for the

distributed force. But to get full value our of our fleet, we need to invest in and provide mid-life upgrades."

We then discussed a subject which is not often the focus of defense modernization discussions, which is really the question of paying for the stretched service lives of equipment and in this case aircraft. The Marines used their aircraft extensively in the Middle Eastern land wars, and the investments in repairing and modernizing those aircraft was never really made. The Marine Corps and its air capabilities has been stretched and needs near term investments.

TWO

Flying the Osprey: Combat Experience and Training Matter

November 2024

There seems to be a cottage industry of folks writing about the difficulty of flying the aircraft and implying that this somehow suggests it is too dangerous for the missions it has been successfully doing since its first appearance in Iraq in 2007.

My own observation has been that training and experience do matter with a combat aircraft which is unique as the Osprey is, for after all you need to know how to fly a plane, how to fly a rotorcraft and how to transition from one to the other and vice versa.

I wanted to talk with an experienced Osprey practitioner with regard to the importance of training, muscle memory and pilot competence and was fortunate to talk on November 20, 2024 with a Marine whom I had the opportunity to interview several years ago.

In a 2016 article which I wrote with my colleague Ed Timperlake, we talked with the then XO of MAWTS-1**,** Lt Col "Cowboy" Nelson. He had been on the deployment to Afghanistan under the command of Lt Col Bianca when I interviewed Lt Col Bianco after an Osprey raid in 2010.1

When we talked to "Cowboy" during our visit to MAWTS-1 in 2016, he was applying his by then extensive experience with the Osprey and connecting to the then new kid on the block, namely the F-35s and referred the new generation of Marines working the intersection of these two revolutionary capabilities as follows:

Cowboy: The new generation is so technologically sophisticated that they will thrive in the evolving digital environment – of which the F-35 is a key element.

Connecting with him again, now eight years later, we returned to a discussion of the Osprey and the importance of generating the flight hours and training commensurate with the combat benefits which the aircraft delivers to the Marines and the joint force.

He started by underscoring the importance of squadron readiness when operating the Osprey, which of course, is true across the flying community. And readiness and training have not been high on recent Administration's shopping lists.

Cowboy: *It is a resourcing issue. If you don't resource and give a squadron the people they need, the parts they need to fix something, the airplanes aren't going to fly effectively.*

And I think that goes back to the flying hours issue.

The trend has been to lower the number of flying hours which Osprey pilots have, which has a direct impact on readiness.

Nothing replaces air sense, by which I mean being off the ground in the air.

It hones your decision making, your experience and your skills as a pilot,

You know, when I was a young man and started out in helicopters, before I went to MAWTS-1, I don't think that I had a year where I didn't fly more than 300 hours.

An average year for a V-22 pilot now is probably closer to 150 hours.

My CO's had 3000-5000 flight hours and today I think we are seeing many with much few flight hours when they take command.

There is little doubt that the question of flight hours contributes significantly to the current mishap rate.

Are we putting pilots in a position where they are more likely to make mistakes because their skills are not refined?

We then focused on a core flying challenge which requires significant training time and that is CALs or (confined area landings).

I once experienced at New River one afternoon 22 landings in a V-22 which is very different from a rotorcraft because the pilot is using the advantages of being a plane to adjust where he will approach the landing zone and then shifts to rotorcraft mode to land.

This is a key area where he felt that flight time should be increased in operating and training with the aircraft.

Cowboy: *Pilots need the muscle memory of getting into landing environments.*

And it's further complicated when you get in the dust.

We've got great simulators, but nothing will replace the time in the airplane for flying and building muscle memory.

THREE

Putting the Osprey Safety Record in Perspective

March 2024

The question of Osprey safety has been brought to the fore again with the accident last year involving an Air Force variant of the aircraft.

Recently, the Department of Defense announced a return to flight of the aircraft.

This is the March 8, 2024 press release from NAVAIR announcing the return to flight:

Effective March 8, 2024 at 7 a.m. EST, Naval Air Systems Command is issuing a flight clearance for the V-22 Osprey thereby lifting the grounding. This decision follows a meticulous and data-driven approach prioritizing the safety of our aircrews.

A U.S. Air Force investigation began following the tragic loss of eight Airmen during the November 29, 2023, mishap off Yakushima, Japan. Our thoughts and prayers are with the families of the fallen.

In response to the preliminary investigation indicating a materiel failure of a V-22 component, the V-22 grounding was initiated on December 6, 2023. The grounding provided time for a thorough review of the mishap and formulation of risk mitigation controls to assist with safely returning the V-22 to flight operations.

In concert with the ongoing investigation, NAVAIR has diligently

worked with the USAF-led investigation to identify the materiel failure that led to the mishap. Close coordination among key senior leaders across the U.S. Navy, U.S. Marine Corps, and U.S. Air Force has been paramount in formulating the comprehensive review and return to flight plan, and this collaboration will continue.

Maintenance and procedural changes have been implemented to address the materiel failure that allow for a safe return to flight. The U.S. Navy, U.S. Marine Corps, and U.S. Air Force will each execute their return to flight plans according to service specific guidelines.

NAVAIR remains committed to transparency and safety regarding all V-22 operations. The V-22 plays an integral role in supporting our Nation's defense and returning these vital assets to flight is critical to supporting our nation's interests. NAVAIR continuously monitors data and trends from all aircraft platforms, so service members are provided the safest, most reliable aircraft possible.

The safety of our pilots, aircrew and surrounding communities remains of paramount importance.[1]

The Osprey has brought unique and transformative capabilities to the joint force and is a key part of the future as well.

The Marines certainly have found that not having the Osprey in their exercise in the Nordics as altering what they can do and what they can bring to the defense of the Nordic region, a region in the throes of a significant integration effort, crucial to European defense and to the defense of North America.

A recent article underscored the importance of providing context to the way the safety issue has been dealt with by the defense press in context.

As Maj. Gen. (Retired) Steve Busby in his article "Groupthink gives V-22 a bad rap" has argued:

The V-22 has long gotten a bad rap. As soon as reports of a fatal accident involving an Osprey off the coast of Japan hit the internet last fall, the critics pounced, and a chorus of uninformed skeptics began posting and commenting, all asking: "Why is the Osprey still flying?"

Supporters of the V-22 are quick to point out that the data tells a

completely different story. In fact, the Osprey is a modern marvel in terms of performance and capability, and its operational safety record is on a par with the most widely used conventional rotorcraft flying in the Department of Defense today.

Like all first-generation cutting-edge technologies, the introduction of the world's first tiltrotor aircraft was a learning experience for everyone involved.

During initial development, the program suffered several tragic accidents including the loss of 19 Marines during an operational test flight in 2000.

That accident, more than any other single occurrence, damaged the reputation of the program. And, in the decades since then, the V-22 has been subjected to an overwhelmingly negative barrage of public opinion.

But facts matter, and the data shows the 10-year average mishap rate for MV-22s is 3.43 per 100,000 flight hours. For context, that places the Osprey's mishap rate squarely in the middle of the other type/model/series aircraft currently flown by the U.S. Marine Corps.

Examined another way, in the 17 years since the aircraft was first introduced into operational service in 2007, there have been 14 loss-of-aircraft mishaps across all three services and one international partner that operate the aircraft—or .82 mishaps per year while flying over 500,000 flight hours.[2]

Busby was there when the 3rd Marine Air Wing transitioned from the CH-46 to the Osprey. In fact, he presided over the last squadron to be trained for the CH-46 in anticipation of becoming a V-22 squadron.

He was quoted in this 2012 story where the Osprey flew at the Miramar Twilight Air Show held in October 2012.

The aircraft has proven its superior capability for Marine Corps operations in Afghanistan, and it soon will have the same impact in the Pacific for transport of troops and supplies in security operations or humanitarian relief, said Maj. Gen. (select) Steven Busby, commanding general of the 3rd Marine Aircraft Wing headquartered at Miramar.

The primary advantage is its enhanced speed and range, coupled with aerial refueling capability. Those attributes effectively allow the Corps to

replace a helicopter fleet with airplanes while retaining the ability to operate off ships at sea or areas ashore lacking runways.

"In the end what it means is the infantryman in the back, or whoever it is, is out of harm's way faster than anything else on the planet. And that's important to us," Busby said.

In the Pacific, with "the ability of that airplane to deploy with the KC-130s that provide refueling, we now have an asset that can range the entire theater. Either on a ship or without the ship … it's going to be a game changer because higher, farther, faster is reality with that airplane."[3]

Safety is a crucial concern; but the ability of tiltrotor aircraft to work in ways that save lives is crucial as well.

That point was made in one interview which Ed Timperlake and I did when we visited in 2014 MAWTS-1, the Marine Corps's key weapons instructor training center.

During our time at MAWTS-1, we had a chance to talk with Captain Justin "Lumbergh" Sing who represents the new generation of Osprey operators who have not transitioned from other platforms. He noted: "I have not flown any other fleet aircraft. I went through the flight school syllabus and straight to the MV-22 FRS. Captain Sing had just joined MAWTS and had been there only three days."

He had two tours at sea with the 26th MEU as part of VMM-266(REIN). The 26th MEU was involved in the Odyssey Dawn Operation, but Captain Sing was part of the split Osprey force and was serving in Afghanistan during that operation. Sing served under Col. Romin Dasmalchi for his first tour and Lt. Col. Christopher Boniface for the second.

During his time in Afghanistan, the Marines were expanding the operational envelope for the Osprey. As he noted: "We started utilizing V22 aircraft for the named operations in a new area previously unoccupied by U.S. forces while I was there."

He described one mission in Afghanistan in which the Osprey landed Marines and then quickly came back to move them out of harm's way.

The quick turn-around capability of the Osprey is an important capability for the "devil dogs" coming out of the back of an Osprey.

Captain Singh noted: "Two Ospreys inserted troops to a particular

landing zone, one on either side of a tree line. We departed and repositioned to a laager point about 15NM away. Fairly soon after, we were called back to move the Marines out of a suspected IED infested area. They could not safely cross the tree-lined ditch at night.

"The next day we found out that the Landing Zone (LZ) where we had conducted the insert had IEDs in it. We just happened to not land on any. That was our first operation after our unit had just arrived in Afghanistan."

Captain Sing highlighted the quick turnaround time, which the Osprey was able to provide to the troops on the ground.

"From the time they called for immediate re-embark when we were on deck at the laager point, to the time they were repositioned, which included us landing, them loading, and us hopping the tree line and landing again was probably less than 15 minutes."

Captain Sing highlighted the impact of speed in an emergency medical situation as well.

"We were onboard the ship and had a sailor with a gallbladder issue. It was about to rupture, and they needed to get him to a medical facility.

"We were just north of Somalia in the Horn of Africa, and the closest medical care facility was in Mombasa down in Kenya.

"This happened while a party was being held on the flight deck, with no flight ops schedule that day. We needed to get this guy to medical care.

"The deck crew cleared the front half of the boat and pulled the V22 out on spot within 45 minutes, and we were in the air 45 minutes later.

"We had to tank on the way, but we had him on deck in Mombasa, Kenya roughly 1,100NM away within 4+30 hours after takeoff."

When asked how the Osprey had advantages over rotorcraft in approaching LZs, the Captain highlighted the advantage of a lower audible signature.

"We can maintain an audible standoff for a little bit longer by staying in airplane mode up at altitude and only descending when approaching the objective area.

"It really reduces the enemy's ability to know we're coming."[4]

FOUR

Re-engineering and Redesign for Enhanced Sustainability

February 2024

There is little question that the re-engineering and redesign under way for the Osprey can significantly enhance readiness rates, and that the Army-Bell partnership designing a new member of the tiltrotor enterprise clearly builds on and enhances this effort.

The first example of this is the nacelle improvement (NI) program.

When discussing sustainment, an important metric is the mission-capable rate (MC). That rate – expressed as a percentage of total time an aircraft can fly and perform at least one mission – is used to measure of the health and readiness of an aircraft fleet.

The key objectives of the NI program have been to improve maintainability and reliability, so as to improve the V-22's mission-capable rate. A reduction in maintenance man-hours to troubleshoot and repair, coupled with reduced failure rate of components results in less downtime and increased mission-capable status.

I wanted to learn more about industry's role in the Nacelle Improvement program, so I turned to David Albin, the

Nacelle Readiness Program Manager at Bell and interviewed him in February 2024.

For 20 years, David Albin served on active duty in the Air Force and in the New Mexico Air National Guard as a helicopter and tiltrotor instructor pilot, completing more than 200 combat sorties in the V-22 and rotorcraft.

From my experience with the U.S. Marine Corps in terms of the evolution of maintenance and sustainability, the first years were focused on getting the aircraft deployed to Iraq and Afghanistan and learning how to support it. The focus was on providing parts to ensure mission availability.

As a digital aircraft, the Osprey generated data on parts performance that allowed the Marines to understand better the maintenance profile of the aircraft. By the time it was anchoring the new Special Purpose-MAGTF or SP-MAGTF, Marines could make a reasoned judgment about what parts needed to be onboard the KC-130Js, which were flying with the Osprey on crisis management missions.

By 2015, enough data had been accumulated to focus on how to shape a sustainment enterprise. This enabled the Marines to achieve better mission-capable rates and lower cost per flight hour for the Osprey.

This is where nacelle improvement entered the narrative, as described by Albin:

When we started the nacelle improvement effort in 2014, we had access to data that allows industry to generate solutions using the fleet's data. We worked with government on the input from maintainers about the aircraft and looked for solutions to enhance the MC rate and lower cost for flight hour.

Albin continued:

There are fixed costs and variable costs in working sustainment for an aircraft. We focused on the variable costs and how to reduce them. How do we reduce the demand for components?

How many times are parts being ordered based on false positives from the diagnostic system?

How do we reduce false positives or get more accurate reporting from the diagnostic system?

How do we improve the choke points in maintenance which reduce MC rate, and drive-up cost?

The focus of the redesign effort was on engineering efforts to improve the operational characteristics of the nacelle.

Albin underscored:

The redesign focused both on service components to reduce the need for in-service repairs, like cracked frame stations, cracked baffles, the hinges and latches were all improved, so that maintainers would have to spend less time dealing with these components and their follow-on effects on the aircraft such as vibration in flight which caused the doors to open and potentially depart the aircraft, for example.

He continued:

The Reliability & Maintainability Team used the data which had been accumulated from the operational fleet to determine what components or areas on the aircraft needed redesign. Based on this work, the engineers went and did the redesign and the NI program – then delivered reduced maintenance man hour rates and enhanced reliability.

These combined effects of reduced maintenance man hours & improved reliability are what have holistically resulted in modified aircraft demonstrating higher MC rates compared to aircraft with the prior variant of nacelle.

This approach which yielded the NI program was rooted in two things: (1) a demand side shaped by the maintainers, and (2) the data generated by the aircraft from the operational fleet.

This information then flowed into industry, which then could parse the data and convert the maintainer input into engineering requirements. The engineers then focused on specific, realistic solutions in a re-design precisely focused on a more sustainable aircraft.

The resulting program had four key lines of effort:

- New build of the nacelles;

- Enhanced reuse of repairable components;
- A new wiring design which improved maintainability, reliability and reduced part count;
- New structure, consisting of targeted improvements to address fleet needs.

What has been the result?

According to data through the end of 2023 from the first users of the NI effort, namely the Air Force CV-22 community, the results have been significant. Twenty-one NI modified aircraft have flown 4,065 hours to date. During those flight hours, the maintainability improvements of NI have saved over 10,000 maintenance man hours or over 400 days of maintainer time on the modified aircraft compared to the time that would have spent on the legacy nacelle design.

Based on the NI program objective to improve reliability by four times, the prediction for NI after over 4K flight hours was 140 component failures. The actual failure rate of NI components to date has been zero, which is a truly significant result.

With regard to the NI maintainability rate, the results have also been notable. The objective was to reduce maintenance man hours by 75%, which after 4K flight hours should have accrued 2,195 hours. The actual accrued maintenance man hours on NI components are at 12-man hours to date, which is a remarkable outcome.

As for the MC rate benefit from NI, in October 2023 AFSOC observed a 10.8% MC rate improvement in their NI modified aircraft compared to the legacy nacelle aircraft in their fleet.

Industry predictions are for an overall MC rate improvement of 7% or higher for the CV-22 fleet once all 50 aircraft in the Air Force fleet are modified.

To data leads to one conclusion: The NI program is a significant step forward in shaping a more sustainable tiltrotor

enterprise. The benefits to the fleet from improved maintainability, reliability and overall MC rate are certain to provide great benefit in the austere and distributed operations employment of the aircraft in the future.

NI is suggestive of how reengineering the aircraft can significantly expand sustainability and its operational life. In an article published on June 10, 2024 by Jo Ann Y. Williams the author cited the perspective of Col Brian Taylor, the V-22 program manager at NAVAIR regarding approaches they are either working or considering at NAVAIR:

A variety of configurations presents a host of challenges for aircraft maintenance, for supply chain management, and for the introduction of new capabilities.

To address this, Col. Taylor reported that the Air Force, Marine Corps and Navy are "coalescing on a kind of standard configuration, which is huge." Huge, indeed!

However, while the services strive for what they consider to be a standard configuration, it's more important for them to strive towards an "operationally relevant" configuration management plan.

Col. Taylor used a helpful metaphor in thinking about this. "If you think about the car that you bought 25 years ago and the car that you bought today, they are very different. They have different systems, and so [we're] trying to kind of normalize all the systems and everything on an aircraft."

A prime example is the Osprey's mission computer system. Col. Taylor explained that because there are two variants of the Osprey's mission computers, two different software builds are required. That's expensive, complex, and time-consuming. Shifting to a single baseline would save taxpayers money and provide more capability, more rapidly, and that improves the experience for V-22 pilots as well.

Col. Taylor noted that "not having the software dependent on hardware" provides "a lot more flexibility in the fleet for mission kitting and things like that."

She then further quoted Col Taylor as follows:

Then there's the need for a cockpit refresh. Col. Taylor used a helpful

metaphor – an older-model car. When you drive a new car off the lot, typically the dash has touchscreens; it interfaces with your mobile devices. A car that's 20 years old has none of that. And, everyone knows it's more expensive to replace 20-year-old parts!

"These are a bunch of screens and displays and keyboards and stuff that were developed, back in the late 80s, so keeping them on the aircraft is pretty challenging," he said. "We are kind of at a tipping point where we are spending enough on just maintaining what we have that it's time to do something different."

The answer from the Joint Program Office is a program called the V-22 Cockpit Technology Replacement, or VeCToR. Col. Taylor noted that commercial, off-the-shelf technologies will be a big part of the solution.

The Open System Architecture (OSA) should be a priority, as it can evolve and adapt as future threats emerge.

Leveraging work on the Army's FLRAA program would provide the Navy and Marine Corps the ability to address legacy system constraints such as computer processing and display interface, while providing a significant cost savings and risk reduction and providing a path to interoperability with the US Army, other services, and foreign militaries who adopt FLRAA variants.[1]

In addition, the following upgrades are in planning and implementation phases for the purpose of increasing the safety and reliability of the V-22:

- Osprey Drive System Safety and Health Instrumentation (ODSSHI): A vibration sensing system upgrade will be implemented to identify components that need to be replaced prior to in-flight faults. Testing is currently underway.
- Proprotor Gearbox (PRGB) pinion bearing redesign: The updated design incorporates new materiel into the pinion bearing for safety and reliability. This improvement is awaiting production and installation.

- V-22 improved Input Quill Assembly (IQA): An improved IQA design based on Hard Clutch Engagement (HCE) investigations will be updated. The prototype design is entering the qualification testing phase.

Notes

1. Looking Back and Looking Forward with the Osprey: The Perspective of LtGen (Retired) Heckl

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1. "NAVAIR Returns V-22 Osprey to Flight Status," *NAVAIR* (March 8, 2024), https://www.navair.navy.mil/news/NAVAIR-returns-V-22-Osprey-flight-status/Fri-03082024-0553
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4. Re-engineering and Redesign for Enhanced Sustainability

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