The STOVL Variant of Joint Strike Fighter:

Are its' Tactical Compromises Warranted?

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The Marine variant of the Joint Strike Fighter (JSF) will be a Short Takeoff and Vertical Landing (STOVL) fixed wing fighter attack platform that will make significant tactical compromises in order to maintain the Marine Corps' unique expeditionary force capabilities. These tactical compromises are necessary to ensure that future Marine Air Ground Task Force (MAGTF) possess an organic sea-based fighter attack platform capable of providing fires in support of future expeditionary operations. The Marine Corps requires it to possess low observable STOVL airframe that will support the unique structure of Marine Corp expeditionary forces. In order for the STOVL JSF to meet the thrust-to-weight requirements of operating from an amphibious ship, its armament and payload capabilities have been decreased. However, the tactical limitations required for STOVL JSF to meet the pure physics of operating as a sea based STOVL fighter attack aircraft need not limit its capabilities to support the MAGTF in follow-on land-based operations. The Marine JSF must be designed in a way, that regardless of available basing, it will be capable of being configured to provide the maximum amount of organic on-call firepower and on-station time in any expeditionary situation. A STOVL JSF, with a larger internal weapons bay

capacity and a lift fan assembly that could be easily replaced with a self-contained 5000lbs fuel cell, would dramatically increase the JSF's ability to support a MAGTF in the high threat environment of the future.

OPERATIONAL LIMITATIONS AND THE MARINE CORP'S VISION

One of the most compelling limitations to future operations is the reduction of overseas bases and the lack of host nation support. It is naive to assume that U.S. forces will always have the basing facilities required within reasonable range of a future conflict. The answer to this problem lies in the merits of Expeditionary Maneuver Warfare.

Expeditionary Maneuver Warfare (EMW) is the Marine Corps' capstone concept for the early twenty-first century. As the reduction of overseas bases and the lack of host nation support continue to place limitations on future U.S. operations, the Marine Corps' ability to operate from the sea in order to secure ports and airfields for follow-on forces will become increasing important to the regional combatant commanders.

The Marines Corps' vision for future EMW at the operational level of warfare is known as Operational Maneuver From the Sea (MCDP 3, 89). Maneuver forces will move directly from the ship to objectives with a minimal

footprint. The majority of firepower, to include aviation, will remain afloat and only go ashore if necessary. The advance weapons systems that enemies will posses will require that units be hard to detect, far-ranging, and fast moving (MCDP 3, 89). The STOVL JSF is the Marine Corps' answer to sea-based indirect and combined arms fires that is hard to detect, far ranging, and fast moving. As a result this makes the STOVL JSF a basic requirement for the success of OMFTS operations. It is clear that fiscally, politically, and operationally the STOVL JSF is the future of Marine tactical aviation, but the question is how does the Marine Corp increase its ability to support a MAGTF in the high threat environment of the twenty-first century?

THE THREAT

In the last thirty years U.S. air power has operated in environments where air assets have been relatively unchallenged in their ability to gain access to desired targets. This is mainly due to the fact that to date the U.S. has faced only first-generation Soviet-made Surface-to-Air Missiles (SAMs) have successfully developed tactics and equipment to suppress them (Hudson 32). Current SAM technology, and the far more capable systems that will follow, pose a significant threat to future employment of U.S. air power. These advanced SAM systems are mutually

supporting, fully mobile, and are equipped with the latest electronic counter-countermeasure techniques (Hudson, 33).

Of the estimated twenty-five first generation mobile SA-6 systems used by the Serbs in the 1999 Kosovo Air Campaign, it is unclear if any were found and destroyed (Zaloga, 49). The ability to employ air power on a battlefield littered with hard to locate, and very capable advanced mobile SAMs, as well as ground units with advanced man-portable SAMs lies in the development of low observable fighter attack aircraft. Like all things in tactical aviation, nothing comes without a price, and the price of low observable is reduced fuel and ordnance capacity. In order to reduce the JSF's radar cross-section to a state of low observable will require all it to be carried internally. The JSF will still be able to carry external stores, but it will increase the aircraft's radar cross-section and reduce its maneuverability to a point, which would dramatically reduce its survivability in a high threat environment.

STOVL JSF DESIGN REQUIREMENTS

The design requirements for the STOVL JSF mandated a Vertical Lift Bring Back (VLBB) capability of 5000lbs of fuel and ordnance on a tropical day. The STOVL JSF's empty gross weight is 29,735 lbs, and it is equipped with a lift

fan design capable of producing 39,800 lbs of vertical lift at sea level on a tropical day. An ability to produce 39,800lbs of thrust minus 29,735 lbs gross weight and 3000 lbs of thrust to safely maneuver the aircraft equals 7,065 lbs of VLBB. As a result the STOVL JSF thirty percent more VLBB then the requirements document mandated (Killea). This means in a worst case, sea-based scenario the STOVL JSF is more than capable of conducting a vertical landing with 4000 lbs, vise 2000 lbs, ordnance, plus two 325-lb radar missiles, and 2200 lbs of fuel for an approach, vertical landing, and reserve (Killea).

INCREASING TACTICAL CAPABILITIES

In order to allow the STOVL JSF to take full tactical advantage of its VLBB capabilities, it would have to be produced with the same bomb bay doors as the conventional take off and landing (CTOL) and carrier (CV) JSF variants. The weight penalty for doubling the internal ordnance capacity of the STOVL JSF is 350lbs for both doors (Killea).

The tremendous tactical flexibility that doubling the internal bomb bay capacity would bring would more than offset this weight penalty, but what would make it truly tactical significant is its added capability to carry more small diameter bombs. Small diameter bombs are 250lbs

precision-guided munitions with the explosive effect of a 1000-lb bomb (Hebert, 3). Equipped with the larger bomb bay doors, the STOVL JSF will be able to carry six to eight 250-lb SDBs per bomb bay, instead of four with the small doors. By adding only 350lbs to the gross weight to the aircraft it's possible to significantly increase the number of targets the STOVL JSF could service per sortie.

A large bomb bay would also make it much easier for the STOVL JSF to carry its force multiplies, its gun. Every part of the STOVL's missionized gun minus the barrel is carried internally in one of the bomb bays. Thus, a STOVL JSF equipped with the large bomb bay doors and its gun could individually target as many as eight targets per sortie with precision ordnance and provide on-call, in-close fires all the while retaining its low observable capabilities.

A CRITICAL OMFTS ENABLER

STOVL JSF is a critical enabler for Operational Maneuver for the Sea (OMFTS). OMFTS acknowledges the Marine Corps' very limited logistical capabilities and the difficulty it would have supporting land-based tactical aviation. It is a well-documented fact that due to the demanding and unforgiving environment of sea-based aviation, land-based aviation units have the ability to

generate and sustain far greater sortie rates than a similarly sized and equipped sea-based unit. OMFTS will require tactical aviation to remain sea-based as long as possible in order to reduce the tremendous logistical strain land based tactical aviation places on a MAGTF. In operations that would support a large build up there would come a point where the ability to support land-based tactical aviation would out-weigh the finite number of sorties that sea-basing could provide.

THE REALITY OF LAND-BASING STOVL JSF SQUADRONS

This author has seen several presentations on the STOVL JSF that addresses this exact situation, and in everyone of them, without failure there has been two slides; one slide showing all the 10,000 foot runways in the world, and the other showing all the 2000 foot runways in the world. The premise behind these slides being that in the present fiscal and political environment, the Marine Corps must sell the need for the STOVL JSF from every angle. These slides are attempting to drive home the point that the STOVL JSF possesses the ability to sustain land-based operations from countless more airfields than any other tactical aircraft. As a Hornet pilot, is author’s question has always been where is the slide that shows the number of 7000 foot or longer runways in the world?

PAST, PRESENT AND FUTURE AVIATION LOGISTICAL SUPPORT

To answer the question of why a 7000 foot runway would be an extremely important to land-basing an aircraft capable of conducting a vertical landing on a ship it is necessary to look the Marine Corps' past and present ability to land base its current STOVL aircraft, the AV-8B Harrier. "Despite all the propaganda that was put out by McDonnell Douglas, British Aerospace, and other Harrier supporters, USMC AV-8B's do not operate out of 72 foot-square pads in jungle clearings, tennis courts, village parking lots or basketball-court sized clearings near the front, other than at Bogue Field, North Carolina" (Hancock 20). So what would a STOVL JSF change to give the Marine Corps the capability to operate from land-bases that the AV-8B couldn't? Although the jump in performance capabilities from the AV-8B Harrier to the STOVL JSF will be measured in light years, the cold reality of the fact is that the Marine Corps will still not posses an organic capability to support a large number of land based STOVL aircraft. Moreover, the STOVL JSF will still require a takeoff roll to get airborne with a large enough payload, to warrant the logistical strain of land-basing them in the first place. This author is not going to argue the point that STOVL JSFs will not be able perform limited operations

from shorter runways and/or a damaged runways that a CTOL aircraft could not, it will. But it will require a substantial amount of very limited Air Force C-17 support, utilizing a secure 4000-foot runway in a low threat area. Air Force lift availability will always be required enable a sustained land based operations of a large enough to warrant the time, and effort of building up and securing a base. The cold hard reality is that limited strategic lift, force protection and payload considerations create limitations. When a large number of STOVL JSF are land-based there will be a point of diminishing returns regarding length of the runway. The shortest runway any fully loaded strategic lift aircraft could takeoff and land is 7000-feet of hard surface. "The main-base expeditionary runway used by land-based Harriers in Desert Storm was 7900 feet in length, hardly a village parking lot" (Hancock 20).

INCREASING A LAND-BASED STOVL JSF'S CAPABILITIES

So the question is what can be done to increase the STOVL JSF's ability to support the MAGTF's fight on a battle field that is littered with advanced mobile SAMs when for logistic and force protection considerations they are based at an airfield with a 7000' or longer runway? The answer lies in the genius of Locheed Martin's lift fan design. The STOVL JSF should be built so that the lift fan

assembly, which weights 2,700lbs, can be easily removed and replaced with a self-contained 5000lbs fuel cell. A 5000 lbs fuel cell their would increase the STOVL JSF's on station time by at least 30 minutes, obviously this will depend on flight profile and configuration during the mission, with no degradation in radar cross section or weapons payload. The ability for a MAGTF to increase its organic STOVL JSF's on station time by 30 minutes, while retaining its firepower, and survivability without increasing its reliance on very limited and vulnerable tanker support when available basing would allow a conventional recovery is an unprecedented capability. Rapid advances in SAM and man portable missile technology will soon make maintaining a JSF's low observable qualities a basic requirement for its ability to provide the type of in-close on-call fires a MAGTF will demand.

SUMMARY

This author firmly believes that the tactical compromises required to field the STOVL JSF, in order to ensure that the MAGTF's possess an organic sea-based fighter attack platform capable of providing combined arms fires in support of future OMFTS operations are warranted. The Marine Corps must take every step to ensure that the STOVL JSF is designed and fielded in way that regardless of

available basing allows for the maximum amount of on-call firepower and on station time in any expeditionary situation. The answer to this requirement is a STOVL JSF equipped with the large bomb bay doors, and a lift fan assembly that could be easily replaced with a self-contained, 5000-lb fuel cell.

Work Sited

Hancock, Ben D “The STOVL Joint Strike Fighter in Support of the 21st Century Marine Corps.” Executive Summary. Quantico, VA. USMC Command and Staff College, 1997.

Hebert, Adam, J. “Smaller Bombs for Stealthily Aircraft” *Air Force Magazine*, July 2001, 50-55.

Hudson, Walter “SAM threat over Iraq” *Proceedings*, October 2001, 32-36.

Killea, Kevin J., Major, USMC. HQMC AVN APP-31. Interview 4 February 2002.

USMC. “Expeditionary Maneuver Warfare”: Marine Corps Capstone Concept. Washington, D.C. 2001.

USMC. Marine Corps Doctrinal Publication 3: “Expeditionary Operations.” Washington. D.C.: U.S. Government Printing office, 1998.

Zaloga, Steven J. “The evolving SAM threat: Kosovo and beyond” *Journal of Electronic Defense*, May 2000, 45-50.